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THE USE OF A DISPLAY CASE FOR SCIENCE EDUCATION

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The author has long felt a pronounced need for the general student in the high school, and especially those students who do not take physics, to gain some knowledge of various basic physical phenomena, and that this need is particularly noticeable and lacking in our high school systems that do not require some course in practical or applied physics for the average student as contrasted to the courses in general physics usually offered to junior and senior students as an elective course.

In many high schools the general physics course is taken chiefly by those students planning on entering technical work or by students going on to college. Thus the enrollment in such courses comprises a small percentage of the student body eligible to take the course in physics, and the balance of the students have little realization of the applications of many simple physical phenomena or knowledge of the varied content of a course in physics.

After much preliminary work in securing the consent of the proper school officials a display case was finally made by a sheet metal fabricating company to our rough plan. It was installed in the corridor wall adjacent to the door leading into the physics classroom and faces into the corridor where students pass on their way from class to class.

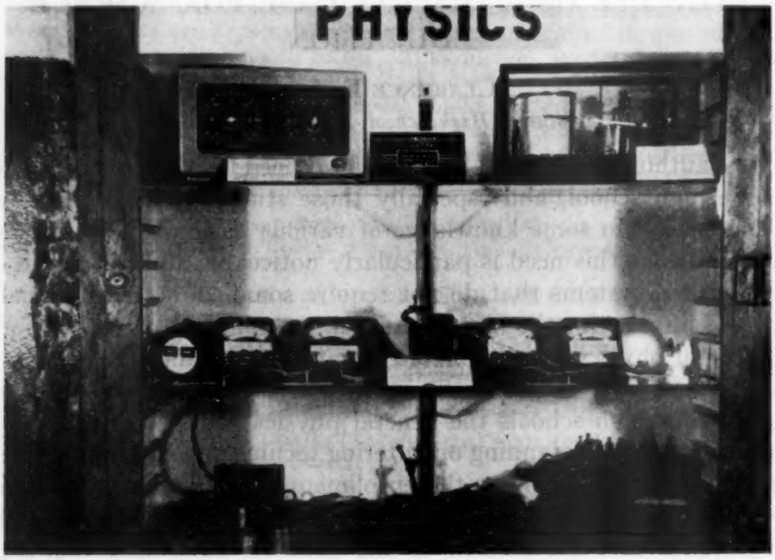
As finished the case measured 91 cms. by 91 cms. inside dimensions. The inside was painted a flat white to eliminate any glare. Channels were placed on either side of the case on 2 inch centers to permit adjusting the height of the spaces between the plate glass shelves. A center adjustable support was found to be necessary if the

glass shelves were to carry any heavy weights and this shelf support was installed after the case had been used a few weeks

The hinged door to the case is located in the corridor and the plate glass in the door slides up and down in channels welded to the door frame. The door also has a good lock on it that cannot readily be picked by the students.

A single twenty watt fluorescent tube was mounted in the top of the case and two electric receptacles were installed when the case was set up. Also an inlet for the cable to the anemometer was provided for before the case was placed in the wall.

The top shelf of the case contains the indicating instrument of the anemometer and a barograph as well as the Taylor weather forecast chart. A small typed card gives a brief explanation of the purpose



of these instruments, which are left in the case as a permanent display. The weather forecast cards are changed daily or as frequently as the physics instructor notes probable changes in the weather.

The lower two or three shelves are used to show and explain various physical phenomena. The first year this display was changed weekly but that was found to take too much time on the part of the instructor and also students indicated they did not have sufficient time to carefully examine all the display in the odd moments at their disposal. This year the exhibits have been left for an average time of three weeks.

The picture accompanying this article illustrates a typical exhibit

and is the last display put in the case while this article was being prepared.

In this picture the topic was transformers. Illustrated in the picture is a frequency meter, voltmeter, and ammeter in the primary circuit or left hand side of the picture; a step-down transformer and voltmeter, ammeter and lights on the secondary side of the transformer. Small typed 3×5 inch cards tell the approximate readings of the various meters and explain briefly in simple terms the principle of a transformer.

On the lower shelf air core transformers, variable or tapped transformers, and step-up transformers are displayed and again small typed cards make brief and simple explanations and explain also why some transformers have air cores and others have iron cores.

Setting up the exhibits and preparing the typed cards usually takes from two to several hours depending upon the complexity of the exhibit. In some displays motion is secured by using an Erector Set motor and Erector Set parts to build various frameworks as in an exhibit last year where the magnet actually was made to move through a coil of wire when illustrating induced currents.

Among topics utilized in past displays that apparently have been successful are; Viscosity, Surface Tension, Principles of the three classes of levers, simple machines, thermostats, magnetism, photoelectric effects, principles of fluorescent lamps, refraction of light and dispersion of light. These are only a part of the ideas that can be used and the limitation is determined by the equipment the department has and the originality of the person who plans the exhibit.

The barograph and its small card of explanation has proven very helpful to our teachers in planning their activities and to the man who directs our school busses. I find that as soon as people know how to interpret the changes in the line drawn on the chart they act as their own weather experts.

In preparing exhibits it has been the experience of the author that druggists, hardware store owners, auto supply dealers, gasoline station owners, and other merchants of the city are only too glad to cooperate in lending such equipment and materials as can be effectively utilized in an exhibit and they do not ask for credit for the loan of the material.

This case seems to be a center of attention in our school, not only with our own student body and faculty, but with visitors to our school who pass this exhibit. The result of all this has been that in plans for a new high school building many such display cases are planned for various departments in the high school.

In the case to be used for physics or science I suggest that the size of the case be increased in width to accommodate a meter stick

and be at least 120 cm. wide. I would also install a second fluorescent lamp in the top placing one near the front of the case and one near the back of the case. Since an egg crate fixture was not used when mounting the light in the present case it was found necessary to place a piece of white, glossy cardboard along the top of the door to shield the spectators eyes from the fluorescent light. This light is left on all the time school is in session and the bulb was only recently replaced after over a year in service. The light has been turned out only when there is an extended vacation such as at Christmas time, Easter vacation, and during the summer months.

To make full utilization of the case takes time and preparation but I think you will secure payment for such in the comments made by students, visitors and other faculty members. As yet no exhibits have been planned and executed by the students but no doubt such will be done in the future. Such student exhibits should be planned in close cooperation with the teacher so that the exhibits are technically correct and the cards of explanation are clear and simple, brief and true. Rubber cement has been found to serve best in attaching cards of explanation to different objects in the display.

DOWN THE HOMESTRETCH

Three years ago the thought was expressed at a Board meeting that CASMT might with a book pay tribute to its organization at the half century celebration. The manuscript became a reality at the turn of 1950, and the book will be placed on sale at the anniversary convention in November. It was a labor of love performed by a large group of loyal members. They now can look with pride to a job well done.

Orders for the attractive book can be placed now by sending $3.00 to Mr. Ray C. Soliday, P..O. Box 408, Oak Park, Illinois.

The Promotion Committee

LAKE BENEATH DESERT

A lake forty miles long and a mile wide has been discovered beneath the sandy wastes of a desert in India.

Study of the physical contours of the Indian state of Jodhpur, followed by an extensive aerial survey, convinced scientists that there was truth in an ancient belief in an underground river beneath the Rajasthan Desert. In Sanskrit literature it was called River Luni or Lavanavari.

An open well was sunk. It struck water only ten feet below ground level. From that one well, two pumps have drawn 120,000 gallons of water per hour for months without drying it—and without affecting the water level of other wells sunk nearby.

AN EXPERIMENT IN SCIENCE FOR THE GENERAL STUDENT

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"If you teach them anything it's a miracle!" No, the science teacher who said this was not speaking of a class of morons. She was referring to the group of students in our high schools who are called general students and her attitude seems to be typical of the feelings which most science teachers have in reference to this type of student.

Most of us will agree that we need a course in the physical and biological sciences for those students who are not going on to college. The tremendous importance which the world now places on the scientist and his work makes it imperative that students understand and appreciate this work when they take their place as citizens in a democratic country. Where attempts have been made to establish courses of this type in the senior high school the results have not been too happy. We have attempted to "water down" the content of sequential courses, we have set up "parallel courses," we have done everything but what is needed. "If you teach them anything it's a miracle!" has been true oftener than not.

Need the prospect be so dark? I think not. An experiment in science for the general student has been underway since 1946 at the Bristol (Connecticut) Senior High School. At the prompting of Principal Carl Magnuson the writer undertook to construct a course of study and to discover methods of teaching the course which would challenge the general student and would result in the achievement of desired goals.

We started with certain assumptions. First, the course was to be an elective one and would have to stand on its own merits and justify its inclusion in the school's course of study. Second, as the result of observation in previous general science classes it was decided to offer the course only to boys and if the experiment worked, we would develop a similar course for girls. The great difference in interest between boys and girls on the same topic and on approaches to topics had been noted and it was thought this was fundamental to some of the previous difficulties. Third, we would make the optimum use of audio-visual aids. Fourth, we would make use of as many techniques as possible to encourage individual projects, provide for individual differences and develop good classroom citizenship. Fifth, we would use community resources whenever possible. Sixth, the course would be limited to seniors.

The following broad integrative elements were decided upon as guide lines for the course:

1. The relation of the scientific with other modes of thought
2. The relation of the individual sciences with one another
3. The relation of science to our past history
4. The relation of science to human history
5. The relation of science to problems of man.

In order to expedite the achievement of these integrative elements the following specific goals were derived:

1. To maintain better health
2. To develop wise consumership
3. To promote more effective human and natural conservation
4. To give instruction in providing materials necessary to life
5. To understand the world of scientific concepts
6. To secure greater comfort, convenience and safety
7. To secure greater participation in the socio-economic life of a democracy
8. To substitute action based on critical thinking for action based on intolerances, prejudices, traditions, superstitions and misconceptions
9. To gain an understanding of the origin and nature of the universe
10. To gain an understanding of mechanical advances in our industrial society.

The topical outline for this course is not very revealing since it follows the outline of a standard general science text. However, I shall list the topics covered and then show briefly how one was developed. The topics: Water, Fire, Fuels, Weather and Air, Food and Medicines, Textiles, Astronomy, Building Materials, Home Equipment, Transportation and Safety. The boys omitted Textiles and the girls, Astronomy.

I should like to discuss teaching the unit on Astronomy. Since our text had no material on Astronomy it was necessary to make use of the classroom library, the school library, magazines, periodicals and newspapers, films and lectures. The problem was posed in this form, "Does the Earth Go Around the Sun or the Sun Around the Earth?" Development followed the historical approach very closely. We discussed the ancients and their concepts, pointing out that their conclusions were the result of visual observations plus arm chair philosophy. The discussions proceeded from Aristotle to Aristarchus to Ptolemy to Copernicus, Brahe, Kepler and Galileo. Emphasis was placed on the evolution of ideas necessary to establish the heliocentric hypothesis and upon scientific method. The influence of scientists on human thought was developed by such examples as the lack of scientific experimentation being traced to Aristotle and the hold which he exerted over the medieval thinkers. We then discussed theories of the origin of the universe and tied this in with the theories concerning the interior of the earth. Some of the references used in this unit are listed at the end of this paper.

It is apparent from the above that the method of attack is probably the biggest variation from the conventional course. The course also varies in the prolific use of all sorts of aids to instruction and in the

scope of material covered. By the use of such films as *Clean Waters* and *The Seventh Column* natural and human conservation became an intimate problem. *Prospecting for Petroleum, Building of a Tire* and *Story of the Storage Battery* brought into sharp focus our mighty industrial system. Individual projects made possible a high degree of individual attention and development. The segregation of classes by sex made possible an approach to each topic determined by the interest and background of a more homogeneous group. An example of this came to light in our unit on transportation. Practically all the boys could drive and approached the study of the automobile with great interest and much practical information. The problem for them was to delve into the theory behind the practical. On the other hand the girls presented an almost opposite picture. None of them could drive, they had no practical knowledge of a car—their operational experience was limited to the radio! An entirely different approach was called for—and followed. This sharp dichotomy of interest and background was noted in several other areas, notably Nutrition, Building and Textiles.

It has been interesting to watch this course take shape and to grow. While many science courses have shown a post war drop in enrollment this elective general science course shows a reversal of the trend. The following table shows relative class enrollments and building enrollments at the Senior Building Bristol High School.

Year	Senior High Enroll-ment	% Increase Over 1945–46	Advanced General Science Enrollment		% Increase Over 1945–46	
			Boys	Girls	Boys	Girls
1945–46	1033	—	17*	13*	—	—
1946–47	1053	2	27	—	59	—
1947–48	1011	−2	32	—	88	—
1948–49	1007	−2.5	27	15	59	13
1949–50	987	−4	43†	22	153	69

* This was a mixed class.
† Two classes of boys.

It is interesting to note the percentage increase in enrollment in comparison with the percentage decrease in building enrollment. This is true in all years except 1946–47 when the building population increased 2% while the course enrollment increased 59%. In 1949–50 the building enrollment decreased 4% while the course enrollment increased 153% for boys and 69% for girls. On the basis of increased enrollments it would seem this course is meeting student needs.

Is this the answer to the problem of science for the general student? No, but it is the beginning. Much remains to be done at Bristol and

elsewhere. The material needs reshaping so that the guidelines and the specific objectives of the course could be brought into sharper focus. The scientific methods of attacking problems could be brought out more clearly if the material in each unit was organized in problem form. The students could then formulate hypotheses, test them on the basis of evidence collected and accept or reject the hypotheses on this evidence. This was done in the area of astronomy in discussing such topics as *The Origin of the Solar System* and *Does the Earth Go Around the Sun or the Sun Go Around the Earth.* The success achieved with these two problems offers encouragement to use the same technique in other areas.

Certainly much needs to be done in the area of text-books for a course of this nature. At Bristol, much use was made of a classroom library, of the school library, of newspapers, magazines and periodicals. This type of reference work should be continued, but the need is still present for a good text to serve as a jumping off point and as an integrating factor.

The problem of laboratory work for general students is a mute one. Whether there will ever be enough laboratory space available for students of this type to do the kind of laboratory work necessary to develop the objectives of the course is highly dubious. They need to go into a laboratory and discover how things operate—not merely to follow a set of directions and fill in spaces in a manual. Probably as much can be accomplished by good demonstrations performed by the instructor as can be hoped for at the present time.

It is quite apparent that the topics used should be revised, added to or deleted. Certainly, a unit in atomic energy is a must at this time and would provide an excellent modus operandi for attaining the aims of the course.

It would seem that this course is beginning to answer the science needs of general students at Bristol High School and it may possibly help in solving the problem at other secondary schools.

REFERENCE MATERIALS FOR TEACHERS AND STUDENTS

Croneis, Carey and William C. Krumbein, *Down to Earth,* University of Chicago Press, 1936.

Hogben, Lancelot, *Science for the Citizen,* W. W. Norton and Company, New York, 1938.

Jeans, Sir James H., *The Stars in Their Courses,* Macmillan Company, New York, 1931.

Kaempffert, Waldemas B., *Science Today and Tomorrow,* Viking Press, New York, 1945.

Lemon, Harvey B., *From Galileo to Cosmic Rays,* University of Chicago Press, 1934.

Moulton, Forest Ray and Justus J. Schifferies, *The Autobiography of Science,* Doubleday, Doran and Company, 1945.

Shapely, Howard, Samuel Rapport and Helen Wright, *A Treasury of Science*, Harper and Brothers, New York, 1943.
Sky and Telescope, Volume II, Number 7, May 1943.

THEY GO TO DIFFERENT SCHOOLS

Gladys Risden
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Static outside our window:

"'ts fourteen."

"'ts thirteen."

"'ts *fourteen* 'cause my teacher says so and my teacher knows more arithmetic 'n your teacher. Your teacher only teaches second grade." Jean, the third grader comes up for air. Nancy, the second grader calmly takes over.

"I know 'ts *thirteen* 'cause I can prove it. Now look. Here's six leaves and here's seven leaves, and I can put three from the six with the seven and now I have ten leaves and three leaves, and three and ten says, 'thirteen,' so six and seven have to be thirteen."

At the grocery store:

Says the clerk, "Sixteen cents for bread and nineteen cents for lemons. How much is that?"

Says third grader Jean: "Give me a pencil and I can find out."

Says second grader Nancy: "I can think it out. Sixteen and nineteen, same as fifteen and twenty. That's a five and a ten and two more tens, five and three tens—thirty-five."

Off for the Sunday School picnic:

Say we with planned forethought: "Five cars, six in a car. How many of us can go this first trip?"

Says third grader Jean: "That's five times six isn't it? Our teacher hasn't told us five times six yet."

Says second grader Nancy: "Five sixes. That's—I don't know but I can find out. Let's see—two sixes, twelve; another two sixes, twelve and twelve—twenty-four; and another six, thirty. Five sixes are thirty."

"How did you know two twelves are twenty-four?" we ask.

"Why, there are two tens, a ten in each twelve, and then there's two twos, and that's twenty-four."

Two children, one seven, one eight. Both with I.Q.'s of 98. The seven year old doesn't have to remember what the teacher says, she can prove it "her own self." She doesn't have to wait for the teacher to tell her, she can find out "her own self." She doesn't have to hunt for a pencil and paper. She can find out "in her head."

Two average children—but they have different teachers.

A NOTE ON A 6″ TELESCOPE FOR HIGH SCHOOLS

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Although amateur astronomy clubs in high schools can be very useful and interesting, if enthusiastically led, a limit is soon reached in practical observation beyond which it is difficult to go without some instrument of precision in measurement or optical aid in observation. At Ridley College, a group of lads observed the various constellations and the first magnitude stars, designed a sundial, and a 36″ celestial sphere, but the chief interest of the Astronomy Club lay in the construction of a 6″ reflecting Newtonian telescope. Owing to the large number of activities at the school, it was not possible to have boys grinding mirrors over a long period of time, and though this is undoubtedly the real test of an amateur's ability, in our case it was decided to purchase the optical parts, already finished, and to mount them ourselves. Since it is possible that other schools may have a similar problem, a brief description of the design and assembly is given below.

The reference text used was "Making Your Own Telescope," by A. J. Thompson, published by the Sky Publishing Corporation. With the help of this excellent book, it was decided to purchase an F.8 6″ diameter pyrex parabolic mirror, aluminized and "star tested." In addition a $1\frac{1}{4}$″ glass 45° prism, ground and aluminized on the diagonal surface, and a $1\frac{1}{4}$″ O.D. eyepiece ($\frac{1}{2}-\frac{1}{4}$″ focal length) were obtained.

The mirror and prism were guaranteed, tested to within $\frac{1}{8}$ wave length of Sodium light. The total cost of text book and three optical parts amounted to $55.00, and of this it would probably have been possible to save $35.00 by grinding the parabolic mirror and the prism.

The photograph accompanying this article shows the telescope mounting, the sundial and the celestial sphere. The telescope mounting is peculiarly suited to be made in a woodworking shop without elaborate tools. It consists of a very firm stand, 3 feet high, made of 2″×4″ fir, with a four legged base. The turntable is heavy 1″ plywood, with a graphite coating on its top surface. A $\frac{3}{4}$″ iron bolt acts as turning axis and holds the tube on the base. The tube itself is 4 feet long, and is made of $\frac{1}{4}$″ plywood, held together by two internal frames of wood and a few steel angles. In this way it is easy to remove the top surface of the tube for the painting of the interior or for adjustments to the optical parts.

The mirror itself is held in a wooden frame which closely fits it with very slight clearance. Two wooden straps across the back hold

the mirror firmly against its outer edges with a light pressure, which in turn is maintained by wedges of corrugated cardboard. This mirror frame and mirror can thus be withdrawn quickly and easily from the tube and yet can be replaced accurately to its three-point

setting against three springs on the tube. The setting is regulated and maintained by three $\frac{3}{4}''$ iron set screws, passing through 1″ plywood at the bottom of the tube, and turned until they press the mirror frame against the set springs.

The diagonal is cemented into a brass tube which has been cut

away to leave only two strong support prongs. This tube holds the eyepiece and can be adjusted over a short range on the plywood telescope tube.

This assembly provides a rigid mounting, capable of being taken apart and carried about readily and of quick adjustment. It has had the great advantages of simplicity and ruggedness which our lads can understand readily and could construct without a machine shop. Our Astronomy Club has had a great deal of fun operating the telescope, and I think the expense of it has been repaid us with our observations of the rings and satellites of Saturn; the clouds and satellites of Jupiter; the star clusters and nebulae visible with a small telescope, but invisible to the naked eye.

The celestial sphere is of great value in explaining apparent movements of the heavenly bodies. It has the planets and sun set upon the ecliptic and outlines of important constellations are being prepared by the boys for its surface. This can be used to locate important constellations and stars at night very readily by sighting through the center, but its use as a model is perhaps its greatest asset at the moment.

ABSOLUTE ANGULAR MEASUREMENT

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All general physics texts use the relationships between angular and linear velocities and accelerations: $\omega = v/r$ and $\alpha = a/r$, where r is the radius of curvature relating these quantities. The relationships may be observed to arise from the angle-distance relation: $\theta = s/r$.

All is well until the student is given a problem such as finding the force necessary to give a mass of 10 grams on the end of a 5 centimeter string an angular acceleration of 172 degrees per second squared. The student should write: $F = ma = m\alpha r$ or $F = L/r = I\alpha/r = mr^2\alpha/r = mr\alpha$. Now he may continue: $F = 5 \times 10 \times 172 = 860$. If he is a careful student, he denotes units: $F = 860$ gm.—cm.—degrees/sec.^{2} or $F = 860$ dynes, as degrees are dimensionless.

Only if he is gifted with second-sight or taught otherwise will he know that this is incorrect. It is very simple to show the error involved by simply returning to the equation: $\theta = s/r$, learned in secondary school plane geometry. The fact that this equation demands that θ be measured in radians is then obvious, as this is the equation used to define the radian.

This is most curious in that it appears to be a unique example in elementary physics of an equation whose truth is not invariant with units.

A CHRISTMAS GIFT

FIFTY YEARS OF TEACHING SCIENCE AND MATHEMATICS is excellently suited for a Christmas gift to a teacher friend. $3.00 secures a copy.

RALEIGH SCHORLING

1887–1950

Raleigh Schorling was one of the great leaders in mathematics and science education of the past thirty-five years, and he was a real friend to hundreds of mathematics and science teachers. His death at his home in Ann Arbor, Michigan on April 22, 1950, took from us one upon whom we had come to depend for vision, for straight thinking, and for sound advice.

The name of Raleigh Schorling appeared in professional literature as early as 1915. At that time the young author already had a background of teaching experience which included a high school superintendency at the age of nineteen, experience in a rural school, a small town high school and Shortridge High School in Indianapolis. His whole career included nearly forty years of teaching in laboratory schools at Chicago, Columbia, and Michigan. He was the first principal of the junior and senior high schools of Lincoln School, Teachers College, Columbia University and he was the organizer and first principal of the University High School at the University of Michigan. Through all of his professional life he kept in close contact with teaching in the elementary and secondary schools. At the time of his death Mr. Schorling was Professor of Education, Director of Instruction and Head of the Department of Mathematics in the University High School and Supervisor of Directed Teaching at the University of Michigan.

Mr. Schorling was a past president (1923–25) of The National Council of Teachers of Mathematics and past president (1933–34) of the National Supervisors of Student Teaching. He was the author or co-author of more than 50 books, including revisions, and many monographs, pamphlets, tests, and research reports. His frequent contributions to the programs and periodicals of the Central Association and the National Council have been important factors in the development of both organizations. During World War II he made valuable contributions to our country's war effort through his association with the Navy training program. The success of Mr. Schorling in his many activities was due not only to expertness in his special field but also to his breadth of professional interest. Throughout his life he gave energetic support to a great many causes which he felt would result in improvement of educational opportunities for all.

No record of the achievements of Raleigh Schorling would be complete without reference to his work with important national committees in the past three decades. Those who had the privilege

of working with him on committees found his enthusiasm and resourcefulness an essential part of their co-operative planning and writing. Mr. Schorling was a member of the committee that wrote the 30th Yearbook on the Textbook for the National Society for the Study of Education; a member of the National Committee on Mathematical Requirements whose report was published under the title "The Reorganization of Mathematics in Secondary Education;" a member of the Committee that wrote the 23rd Yearbook on Education for Teachers for the National Society of College Teachers of Education; and he was chairman of the recent important commission on Post-War Plans of The National Council of Teachers of Mathematics. He was also a member of the A.A.A.S. Cooperative Committee on Teaching Science and Mathematics and a frequent contributor to statements of the Committee's program and recommendations.

As a part of a busy life he found time to have an interest in numerous less directly professional activities, and he knew the importance of these interests for the teacher. He was an ardent follower of Michigan's athletic program, a lover of the woods and outdoor sports, an alert observer of current affairs, and one who had time to make friends and to keep them. His fine sense of humor was a great asset to him in his relations with people and in all of his work.

Mr. Schorling was a devoted husband and father. While he was a member of the staff of the University High School of the University of Chicago he married Marie Louise Oury of Chicago. Mrs. Schorling, a daughter, Ruth Mary, and a son, Otis William, survive. Another son, Clark, was killed while serving with Patton's army and is buried at Arlington cemetery.

A part of Raleigh Schorling's philosophy toward teachers and teaching is revealed in his frequently expressed conviction that in a very real sense any improvement in the status of teachers, and any statement of their rights, is an improvement in the status of youth, and a statement of the rights of youth. His own acceptance of the importance of teaching through the interest of the pupil which he followed in teaching and writing did a great deal in directing others toward that end. Especially for his genuine interest in the work and problems of others, students and teachers alike, and for his ability to express his ideas with unusual clarity and to put into his writings his own sound philosophy, will he long be remembered.

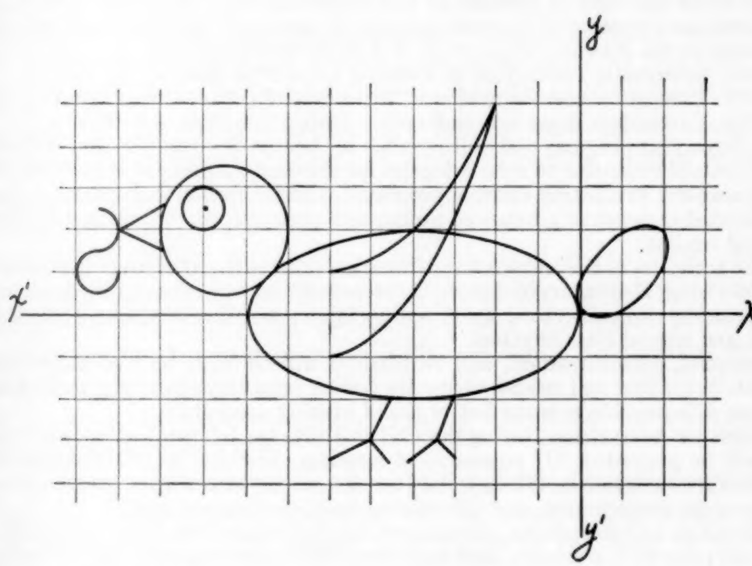
John Mayor
Edwin Schreiber
Philip Peak

COM(N)ICS

NORMA SLEIGHT
New Trier Township High School, Winnetka, Illinois

The problem which follows can be solved by any good student of intermediate algebra who has finished the topic of graphing the second degree equation in two unknowns.

Directions. Place axes near the center of a sheet of rectangular graph paper. Then plot the following, using these axes. The computation involved need not be arduous if substitutions are made without expanding expressions. For example, in equation 2, solve for $x+8\frac{1}{2}$, then x.



1. $\dfrac{(x+4)^2}{16}+\dfrac{y^2}{4}=1$
2. $(x+8\frac{1}{2})^2+(y-2)^2=\frac{9}{4}$
3. $(x+9)^2+(y-2\frac{1}{2})^2=\frac{1}{4}$
4. Plot point $(-8.9, 2.5)$
5. Join $(-11, 2)$ with $(-9.9, 1.5)$ and $(-9.9, 2.5)$
6. $(x+11\frac{1}{2})^2+(y-2)^2=\frac{1}{4}$ for $x>-11\frac{1}{2}$
7. $(x+11\frac{1}{2})^2+(y-1)^2=\frac{1}{4}$ for all values of $x<-11\frac{1}{2}$, then for all values of $y<1$
8. Join $(-3, -1.9)$ and $(-3.4, -3)$
   Join $(-4.5, -1.9)$ and $(-5, -3)$
9. Join $(-3.4, -3)$ and $(-3, -3.4)$

Join $(-3.4, -3)$ and $(-4.1, -3.5)$

10. Join $(-5, -3)$ and $(-4.6, -3.5)$
    Join $(-5, -3)$ and $(-6, -3.4)$
11. $(x+6)^2=4(y-1)$ for $x=-6$ to -2
12. $(x+6)^2=\frac{8}{3}(y+1)$ for $x=-6$ to -2
13. $5x^2-6xy+5y^2-4x-4y=0$

THE READING CLINIC, DEPARTMENT OF PSYCHOLOGY, TEMPLE UNIVERSITY

1951 Reading Institute: January 29 to February 2, inclusive

The Eighth Annual Reading Institute at Temple University has been announced for the week of January 29 to February 2, 1951.

EMPHASES: Another three-year program of one-week institutes has been announced by the Reading Clinic Staff of Temple University:

1951: Systematic Instruction in Reading (Jan. 29 to Feb. 2)
1952: Prevention and Correction of Reading Difficulties (Jan. 28 to Feb. 1)
1953: Curriculum Approach to Reading Instruction (Feb. 2 to Feb. 6)

This three-year program makes it possible for boards of education and state departments of education to send delegates for the dual purposes of organizing new programs and evaluating existing programs. The theme for each year has been established in terms of a balanced program of remedial, corrective, and developmental reading.

The activities of the one-week institutes are differentiated to meet the needs of the following: elementary and secondary teachers and supervisors, college instructors, reading clinic directors, speed reading laboratory directors, school psychologists, and special class directors.

Seminars, demonstrations, and evaluations will be made by well-known specialists in reading and related fields. By setting up a three-year program of emphases, it is possible to make better use of visiting specialists.

TYPES OF ACTIVITIES: During the 1951 institute the following sequence of topics will be presented: (1) sequences of language development, (2) reading and personality integration, (3) materials for systematic instruction, (4) procedures for concept development, and (5) refining basic reading abilities.

Activities include lectures, demonstrations, laboratory practices, evaluation of reading programs, seminars, staff meetings, and conferences with staff members.

INSTITUTE STAFF: The Reading Clinic Staff and members of the various departments of the University participate in the Institute activities. Nationally known specialists, selected on the basis of their professional contributions to developmental, corrective, or remedial reading, have been added to the Institute Faculty.

EVALUATION MEETINGS: Half-day sessions have been organized to evaluate local and state reading programs. Special sessions will be held on reading needs at the elementary, secondary, and college levels. This permits boards of education to have existing programs appraised and projected programs evaluated. Delegates should write for specific instructions on the preparation of their reports.

EXHIBITS: In addition to an unusually fine selection of exhibits on books, supplies, and equipment, a special exhibit of school work has been planned.

ENROLLMENT: Enrollment is limited by advance registration. For a copy of the program and other information regarding these institutes, write to:

Dr. Emmett Albert Betts, Director
The Reading Clinic, Temple University
Philadelphia 22, Pa.

AN APPLICATION OF THE PARABOLA

HUGH M. GILMORE, JR.
223 Forest Hills Drive, Wilmington, N. C.

The project here outlined was undertaken to illustrate some principles in mathematics and physics and to relate the activities of the classes in these subjects. It was suggested and outlined by the writer, at the time mathematics teacher at the Wm. S. Hart Union High School, Newhall, California. The construction was carried out by Mr. Roy W. Dundon, the science teacher, and by Mr. Robert Green, a student.

The idea grew out of a class discussion of the properties of the parabola. After mentioning automobile and flash-light reflectors as inverted examples of the principle that rays entering a parabola parallel to its axis are reflected to its focus, the writer stated that it should be easy to make a solar furnace by applying this fact. This suggestion was taken by Mr. Green to Mr. Dundon who also became interested, and certain preliminary details were agreed upon. The sides would be parabolic sections, and a reflecting surface would be curved around them. This, with a glass tube along the focus, would complete the apparatus. Construction problems dictated the use of a cylindrical surface with a linear focus instead of the more effective surface of revolution with a point focus. We proposed an overall length of about five feet and a tube of $\frac{1}{2}''$ diameter. Making the extremely crude assumption of 100% efficiency, this meant that all the sunlight falling along a 60″ line would be concentrated on the $\frac{1}{2}''$ tube, so that we would increase by 120 times the solar energy impinging on the tube.

It was a small matter to compute the dimensions of the parabolic sections which formed the sides of the trough. The width of the mirror was immaterial except as a factor in the bulk of the unit. For convenience and efficiency the latus rectum was chosen as the bounding chord. Having plotted the points necessary for graphing the parabola, the writer turned the figures over to Mr. Green who made the graph on a large piece of wrapping paper. He then cut it out to serve as a template for cutting the sides from 1″ pine stock which was chosen because the stiffness of the back material necessitated stout nailing into the edges of the side pieces. It had been hoped to use sheet metal for the mirror but this proved too costly. Instead a strip of $\frac{1}{8}''$ Masonite was nailed to the side pieces. The springiness of this material served admirably to smooth out small irregularities in the sawing of the parabolic edges. A reflecting surface was provided by glueing to the Masonite sheets of aluminum foil bonded to paper, a material generally sold for the wrapping of gifts.

Beading was placed along the edges of the paper to keep it from curling in the sun, and a metal cover fastened over the 10 mm. glass tube finally used prevented the breeze from cooling it.

Once the heater was set up in the sunlight, properly aimed, and the tube filled with water, it took about three minutes for both the water and student curiosity to come to a boil. A gratifying degree of interest was generated.

The picture shows the heater in operation. At the left is Mr. Green who has since received a scholarship in engineering at the University of California, Los Angeles; in the center, Mr. Dundon is watching a thermometer; and the writer is checking the efficiency of the reflector with a photo-electric lightmeter. A more elaborate extension of the project might consist of mounting the heater on a frame so that it would be pivoted to move in the plane of the sun's apparent orbit and be driven by clockwork to follow the sun.

MOST VALUABLE TRACERS

Arsenic and gold in their radioactive forms are two of the Big Six medically valuable radioactive tracer atoms at the present time, Dr. Leon O. Jacobson of the University of Chicago declared at the sixth International Congress of Radiology.

More than 700 radio active tracer atoms have been prepared, he reported, but he called these six the most valuable.

Radiophosphorus is used in many forms of diseases of the blood and blood-forming organs and radioiodine is used to treat thyroid gland cancer. The other four are promising, Dr. Jacobson said, but have been less thoroughly explored.

THE SCIENTIFIC METHOD IN USE

HARRY C. LASSEN
Carl Schurz High School, Chicago, Illinois

A beauty operator was trying to sell a customer an oil permanent. It would be much better, she thought. Oil is good for the hair. Gives it life.

'Well, I don't know,' said the customer. 'I should think it would be the worst thing to use with the waving fluid. I don't understand chemistry, but I just thought they would go against each other, sort of. Wouldn't oil counteract the fluid?'

'Well, I don't know,' replied the operator. 'Maybe it would.' Then, suddenly brightening, 'I never thought about permanents that way, being chemical, that is. I had chemistry in school back home and I always got the highest mark they gave. I liked it, but I've never connected it with anything outside of school.'

'No,' agreed the customer, 'I don't really, either. It's pretty hard to see any connection.'

'No,' said the operator, 'I guess there just isn't very much connection.'

That seemed to exhaust the subject. While the ladies let their conversation run toward more promising areas, let us return to their topic.

Science has dug itself in as a significant part of everyone's education. Offerings are scheduled from kindergarten through the junior college. Rare indeed is the high school graduate who has had only a thousand lessons in science. This is as it should be in an age of hydrogen bombs, anti-histamine, cyclotrons and big telescopes, the electron microscope and the diesel locomotive, and all the innumerable manifestations of science and technology. True enough, the graduate has taken science courses, but for the population as a whole the outcomes are somewhat questionable. Like the lady in the beauty parlor, many feel incompetent to apply scientific thinking to everyday situations.

Science, like football, is well taught. We produce high grade Ph.D.'s with the generous even flow of an automobile assembly line. The cream of the stream flows into governmental projects and industry; the rest of it flows into the universities to produce more Ph.D.'s. In a more naive age we taught Greek to people who would teach Greek to people who would teach Greek, etc. Today we deplore such sterility.

So eager are we to produce Ph.D.'s, so efficient is the assembly line, that a day must come when industry and government cannot absorb so large a part of the widening stream. Then more and more scientists will become available to colleges and high schools. What will be the

effect on the product of the schools? Prediction is notoriously dangerous, but perhaps it would be interesting to conjecture.

Today our schools offer instruction in the sciences through teachers who are not principally scientists but who are more or less broadly educated and who have some grasp of educational principles. These teachers, in general, use text books written by experts who are scientists first and educators only incidentally. Courses of study which would have been commendable in 1900 are now offered in all seriousness as a means for adjusting the pupil to our twentieth century civilization. The struggle to provide the pupil with a functional acquaintance with science and the scientific method is almost too difficult. We teach facts and principles, theories and laws, moving these objects from book to mind like so many pieces of freight to be placed aboard ship before an appointed hour. As a result the typical American high school graduate emerges with some vocabulary from several sciences but very little understanding. He has temporary possession of some facts but only a sketchy comprehension of the physical and biological parts of his environment. We teach technical sciences, not use of the scientific method.

Would more Ph.D.'s in the schools tend to further technicalize our high school subjects? We are already teaching children the valence of the chromate radical, knowing very well that hardly one person in fifty will ever meet a life situation requiring such knowledge. One college teacher told his freshman class that they were inadequately prepared,—they didn't know the radii of the 96 atoms! The present generation of high school teachers haven't started teaching such matters but we are heading in that direction. The more time we spend in building up ware-house stocks of facts, the less remains for providing experiences in using the scientific method.

Providing the facts of science are surely justifiable, even necessary, but too often they usurp the place of the more desirable activity. We labor to establish the idea that a solute depresses the freezing point of a solution, and that seems a practical thing to teach. Yet many a person who never heard of a solute adds alcohol or Prestone to his radiator fluid. There are valid reasons for continuing to teach this particular idea but we need to be more interested in the alteration of the pupils' thinking and behavior than in his ability to regurgitate the words of the principle itself.

The scientific method has altered our world. It seems almost certain that without it we would still be living under sixteenth century conditions. Everyone agrees that no more powerful instrument for learning the laws of nature can be hoped for. Strangely enough, however, the men who use this great instrument so wondrously well for adding to

our health, comfort, and convenience are hardly more skilful than others in solving the problems of daily life.

Some of the Atomic Scientists have banded together to awaken the public to possible consequences of their work. Only the atom bomb was strong enough to cause such a reversal of custom. Normally the research scientist loves laws more than he loves humanity. For him to observe social consequences of his researches seems like treason to his class. He applies his powerful method to the solution of problems in his particular field but alas, rarely extends its use beyond that. He trains his students rigorously and they in turn rigorously train others, but use of the tool is rigidly confined to laboratory problems, not life problems. If the high school student is to benefit by using scientific method in the solution of his own problems he must be trained by people who see the worth of the scientific method in life as well as in the laboratory; people with general education and a thorough grounding in the philosophy of education, as well as training in the scientific specialty of his choice.

If we consider secondary education as embracing high school and junior college a curious anomaly appears. This period is devoted to general education. In his first year the high school student studies general science. Here he meets science for the citizen, learns a few names of great scientists, and gets his first taste of scientific method. In his second, third, and fourth years he may study, if he wishes, the specialists' sciences, biology, physics, and chemistry. Then as he passes into junior college the philosophy changes: now he must pick up where he left off three years ago and continue with a more substantial general science under the name of The Survey Courses.

These courses form one of the bright spots in the modern curriculum, presenting opportunity for thrilling exploration of our expanding universe. But why did the student have to dismount, stumble among the futilities of the 1900 curriculum, only to remount at the age of eighteen? Surely his thinking has undergone no such curious revulsions! Why has he not been offered a four-year continuous, self-consistent course in science, all of it enriching his mind and character and all contributing to steady development of his ability to think scientifically?

With adequate training in science through the grades and high school the student would be ready to study such specialized sciences as he may need for his vocation, or in the absence of such need he would drop science. He could consider himself reasonably well informed, could read intelligently of the progress of science in his newspaper, and above all he would be better able to think and behave rationally.

Before this happy day can arrive we must have a generation of teachers who believe in and live by the scientific method and can develop students who will use the scientific method in solution of life problems. Teacher training institutions should find ways to train science teachers whose objective will be to prepare students for life as well as for laboratory.

Perhaps the reason this has not been done is that the specialists who teach science at higher levels are scientists by inclination and training, teachers secondarily. The scientist earns his title of scientist by long years of costly study in a field of high-powered competition. He becomes a scientist by effort, but the title 'teacher' he casually bestows upon himself.

His own teachers have focussed their attention on transmission of knowledge; that is, on the production of ever more intensely specialized specialists. Eminently successful in achieving their objective, they rarely if ever question the validity of that objective. When the educational philosopher timorously asks, 'What is the purpose of this activity?' the specialist is stung to wrath. Since everyone grants that he has vast knowledge and grand achievements, why is he not immune from intrusion of outsiders? Competent in his field, is he not competent to teach?

Thus arises ill feeling, generally recognized but rarely mentioned in print. The wall between subject matter experts and administrators who seek to provide general education grows ever higher. What a Herculean task to tear it down!

The educational expert has two important contributions to make: economy through clarification of objectives and economy through methods of teaching. Even the extreme specialist whose modest ambition is merely to transmit vocational information can profit by both. But the genuine teacher, whose job is education, the shaping of men, draws his main support from educational theory. He is half scientist, half humanist: that is to say, he is an educational theorist. He is equipped to teach by light of the aphorism uttered by Hippocrates almost twenty-five centuries ago: 'I approve of reasoning if it takes its point of departure from observed fact and methodically draws its conclusions from the phenomena.'

A TIMELY SUGGESTION

Have you paid your dues for this year? If not, send your check *now* to Ray C. Soliday, P. O. Box 408, Oak Park, Illinois and avoid waiting in line at the Convention.

CONCEPTS FOR CERTAIN FUNCTIONAL MATHEMATICS COURSES

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The immense values of mathematics as a servant of mankind and as a permanent part of research are universally recognized. From an informational, from a computational, and from a cultural standpoint, its place in the sciences and in the practical arts make it indispensable in our living. It, therefore, behooves all teachers to organize and present mathematics in a manner that will influence the learner to strive not only to learn but also to master the basic ideas and principles involved.

The sources of mathematical power, which enables an individual to develop more effectively as a citizen and to serve more effectively as a contributor to society, are primarily its basic concepts, principles, procedures, and skills. Consequently, the teaching of mathematics should provide for:

1. The understanding and appreciation of
   a. The language and vocabulary of mathematics
   b. The basic concepts and principles
   c. The quantitative relationships of daily living
2. Competency in basic skills and in the solutions of problems
3. A degree of mastery which will assist an individual in feeling adequate and secure
4. Practice in clear analytical thinking that leads "toward the *process* of thinking rather than toward the *product* of thinking" (1)
5. The creation of an impelling desire for continuous mathematical growth
6. Training for transfer of mathematical values to other fields of human relationship
7. Training in the selection of that which has significant and enduring values

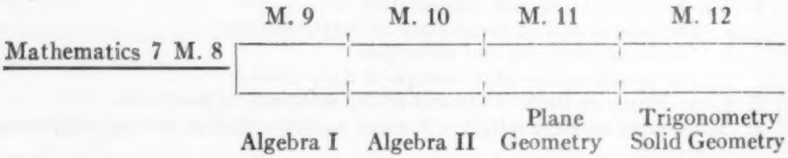
To provide each pupil with experiences that will develop him into a well-adjusted individual is one of the important functions of our secondary schools. Granted that these experiences should be determined in part by his own purposes and interests, yet let us not forget that it is also the responsibility of the school to offer suitable materials and wise guidance in shaping the pupil's purposes, both in the light of his present and his future needs. Only by meeting these needs can high school pupils be so trained that, upon graduation, they will be able to serve accurately and efficiently in the many situations that involve mathematical thinking.

We all know that industry and many other enterprises have found it necessary to rebuild and retool since the last war. In the same sense there has existed an urgent need to bring some of the secondary mathematical offerings up to a higher plane of usefulness. Work along this line was begun in June 1948 by a group of secondary mathe-

matics teachers, authorized and sponsored by the Florida State Department of Education and the University of Florida. In August 1949 the work of these thirty-six participants was completed, and in October 1949 this material was approved as Bulletin #36 by the Florida Courses of Study Committee and the Florida State Department of Education. Research studies involving the present secondary mathematics curriculum led the Workshop Group to these specific considerations:

1. Not to alter at this time any of the traditional compartmentalized courses now being taught
2. To pull out of the compartmentalized courses mathematical concepts necessary for effective living in this mechanical age
3. To add topics closely related to personal finance, consumer education, and responsible citizenship.
4. To organize these materials into a sequence of mathematically sound, functionally worthwhile, courses to be designated as Mathematics 7, Mathematics 8, Mathematics 9, 10, 11 and 12.

The accompanying diagram shows the relationship of the traditional courses and the functional courses proposed by the Workshop Group.



At the beginning of the ninth grade it is noticed that a choice is possible. The traditional courses are available for those who have reasons for taking them. The functional courses, which are especially built to challenge pupils to find new interests in the applications of mathematical methods to situations that may have deeper meanings for them, are available for the much larger group.

It is of prime importance that teachers, administrators, and guidance officers keep in mind that the traditional and the functional curricula both are mathematically sound in nature; their primary difference is in their purposes. With these two curricula available to choose from, the past procedure of ferreting out the bright pupils and assigning them to the traditional courses should be a thing of the past. This does not mean that bright pupils should not be in the traditional courses. It simply means that all of them should not necessarily be there. Many educators feel that it is not right to penalize the pupil who happens to be above average intelligence by insisting that he take the traditional courses when the functional courses may come much closer to meeting his needs and may prove more interesting. Let it be reemphasized then that these functional courses are built for the bright pupils, as well as the average ones,

and that they should be open to any bright pupil who desires the functional approach.

The Workshop Group firmly believed that pupils should be urged to complete two years of mathematics beyond the eighth grade. This seems necessary in order:

1. To reduce the over-load from the ninth grade course
2. To place materials in grade levels compatible with the level of the maturity of the pupils
3. To provide spiral learning of the mathematical concepts, skills, and materials essential to effective living

In the minds of those who are familiar with the materials for the functional courses there are no objectionable reasons why pupils who have satisfactorily completed Mathematics 9 and Mathematics 10 should not choose to elect junior or senior level traditional courses which they consider necessary for specialized work. Many of the pupils who complete Mathematics 9 and 10 will, of course, elect to continue the functional sequence and complete Mathematics 11 and Mathematics 12. The larger number of students, however, would not take mathematics beyond Mathematics 9 and Mathematics 10.

The formula used in the actual constructional procedure of building these proposed functional courses was a relatively simple one; namely, concepts + principles + a carefully ordered grade placement chart + suitable materials = functional courses.

That there exist certain mathematical concepts which are fundamental to each course in mathematics is common knowledge; they are the very heart of the course and the foundations which support the materials. To understand the full import incorporated in these concepts gives assurance that the content material will take on greater meaning. Not to understand these basic ideas means that the courses which they support are likely to be ineffective. The Workshop Group was able to isolate sixty-one concepts as being basic to the six functional courses under discussion. Some of these were, of course, used before the seventh grade. The list includes

	Grades					
I. Concept of number						
A. One to one correspondence	7	8	9	10	11	12
B. Digit	7	8	9	10	11	12
C. Integers (whole numbers)	7	8	9	10	11	12
D. Zero	7	8	9	10	11	12
E. Common fractions	7	8	9	10	11	12
F. Decimal fractions	7	8	9	10	11	12
G. Mixed numbers	7	8	9	10	11	12
H. Denominate numbers	7	8	9	10	11	12
I. Abstract numbers	7	8	9	10	11	12
J. Approximate numbers	7	8	9	10	11	12

K. Rounded numbers	7	8	9	10	11	12
L. Exact numbers	7	8	9	10	11	12
M. Prime numbers	7	8	9	10	11	12
N. Composite numbers		8	9	10	11	12
O. Literal numbers		8	9	10	11	12
P. Signed or directed numbers		8	9	10	11	12
Q. Rational numbers			9	10	11	12
R. Irrational numbers			9	10	11	12
S. Imaginary numbers				10	11	12
T. Complex numbers				10	11	12
II. Concepts Basic to Operations						
A. Sum	7	8	9	10	11	12
B. Difference	7	8	9	10	11	12
C. Product	7	8	9	10	11	12
D. Quotient	7	8	9	10	11	12
E. Exponents		8	9	10	11	12
F. Logarithms					11	12
III. Concept of Per cent and Percentage	7	8	9	10	11	12
IV. Concepts Basic to Measurement						
A. Point	7	8	9	10	11	12
B. Lines	7	8	9	10	11	12
C. Angles	7	8	9	10	11	12
D. Planes	7	8	9	10	11	12
E. Plane figures	7	8	9	10	11	12
F. Solid figures	7	8	9	10	11	12
V. Concepts of Measurements						
A. Length	7	8	9	10	11	12
B. Directed magnitude			9	10	11	12
C. Area	7	8	9	10	11	12
D. Volume	7	8	9	10	11	12
E. Angular measure	7	8	9	10	11	12
F. Weight	7	8	9	10	11	12
G. Time	7	8	9	10	11	12
H. Money	7	8	9	10	11	12
I. Heat			9	10	11	12
J. Velocity			9	10	11	12
K. Acceleration			9	10	11	12
L. Power		8	9	10	11	12
VI. Concepts of Functional Relationship						
A. Graphs	7	8	9	10	11	12
B. Equations		8	9	10	11	12
C. Series				10	11	12
D. Trigonometric ratios			9	10	11	12
E. Slope				10	11	12
F. Variation			9	10	11	12
VII. Concepts of Comparison						
A. Ratio and proportion	7	8	9	10	11	12
B. Similarity			9	10	11	12
C. Congruency		8	9	10	11	12
D. Equivalency		8	9	10	11	12
E. Symmetry	7	8	9	10	11	12
F. Inequality			9	10	11	12
G. Statistical averages	7	8	9	10	11	12
VIII. Concept of Locus		8	9	10	11	12
IX. Concept of Limits			9	10	11	12
X. Concept of Infinity				10	11	12
TOTALS	35	44	55	60	61	61

Even though a mathematics course cannot be built without concepts, to present them merely as separate ideas will never make a good course in mathematics. In order to extend properly their meaning and their usefulness it becomes necessary to incorporate them into so-called statements, rules, and principles. As any good teacher knows mathematics has to be taught as a system of principles; there is no other acceptable way to teach it. Thus the Workshop Group felt that there existed a vital need for a comprehensive list of those basic and working principles which were essential to the proposed functional course. Such a list was prepared and may be found in Bulletin #36.[2]

It was the expressed opinion of the Workshop Group that each teacher should know all basic principles, which had to do with her work in mathematics, in a manner that would enable her to respond to them as quickly as she would multiplication facts. If the teacher does not know them well, how can she recognize them and emphasize them at the proper time? It follows, of course, that if the principles are not taught properly as to time and place that such results as are obtained will be mechanical in nature and almost entirely meaningless to the pupils.

To be certain that essential concepts and principles found their way into the proposed functional courses at suitable times and places, a Grade Placement Chart was constructed. It is admitted that no Grade Placement Chart, no matter how well done, is ever going to be accepted by all readers. Nevertheless the Grade Placement Chart afforded the Workshop Group the best procedure for circumventing certain important factors which it labored to have under control at all times. It provided a constant check on such factors as:

1. A horizontal representation of the gradual unfolding of a concept over a period of years
2. A vertical representation of the basic content for a single grade
3. A means of relating the content materials to the basic concepts

One example of how this Grade Placement Chart shows a horizontal unfolding of an idea is indicated under the heading of Approximate Number (3). The Chart says that for Grade Seven a distinction should be made between "exact number" and "approximate number." Also reasons for, and practice in, "rounding off numbers" should be given. In Grade Eight the chart calls for the development of the idea of, "possible error" and "precisions"; the "addition" and "subtraction" of approximate number; and the use of rounded numbers in making graphs and in the estimation of results. Grade Nine calls for a consideration of "significant digits"; the meaning of "accuracy" as used in connection with multiplication

and division of approximate data; and the "rules of procedure" for "multiplying" and "dividing" approximate numbers. In Grade Ten a distinction is to be made between "precision and accuracy"; also much practice should be given in applying the rules for adding, subtracting, multiplying and dividing data of interest from actual measurements. It is suggested that Grade Eleven give attention to "relative error," "degree of accuracy," and "logarithms" as approximate numbers. Grade Twelve is to reemphasize and use all principles and procedures of computation with approximate numbers.

It is easy to see that it would be extremely bad teaching to attempt to give the full meaning of the approximate number concept to seventh graders: first, because some phases of "approximate number" are not compatible with the learning ability of these pupils; second, this particular concept is sufficiently complex to justify repetitions in several grades to provide the benefits that come from spiral learning. Not to give any attention to this concept, which is so important at the seventh and following grades where measurements are so common, is of course an educational mistake.

The content material for the proposed functional courses—Grades Seven through twelve is presented for each grade under approximately ten broad headings. The suggested materials are given in sufficient detail to make it possible for any interested teacher to use them as a basis for her class work. On each page of materials the extreme left-hand column lists the concepts involved; the extreme right-hand column gives Teaching References sufficiently adequate to clarify the materials and the necessary procedures. While every effort was made to build the content around pupil interests, yet it was recognized that this was an objective affected by so many variables that no bulletin of materials could hope to meet it completely. Even though the Workshop Group felt it should be the responsibility of the teacher in each classroom to provide for the individual needs of each pupil, it also felt that the content in these functional courses is of such a nature and quantity that it will greatly help to provide for individual differences and enrichment purposes. Also, in the consideration of the interest and the needs of the class, no time element in which a particular topic should be developed has been suggested. This, too was considered to be mainly a matter which depends upon the judgment of each teacher.

Mathematics 7 and Mathematics 8 show no radical changes from the present materials commonly used in these two grades. Working on the hypotheses that the mathematical needs of a seventh or eighth grader are few, but that his interests are manifold in nature, some topics were added, some topics were postponed, and a few others omitted.

As has been mentioned before, in building Mathematics 9 and Mathematics 10 it was assumed that pupils should take both courses. This appeared to be the only way to prevent over-loading Mathematics 9 and at the same time to provide opportunity for more mathematical reasoning in the course.

In a sense Grade Ten represents a new venture in curriculum building. Pupils who finish this course should find themselves mathematically competent (4). Although these tenth-grade materials are not necessarily algebra, geometry, or trigonometry, yet these traditional courses were critically analyzed and such parts of them as could be used to strengthen and forward the functional purpose of Mathematics 10, were used. There is an increase in mathematical rigor in this grade even though, as in Mathematics 9, much emphasis has been given to develop understanding through experimentation and application. Mathematics 10 also contains such portions of finance, budgeting, taxes, consumer education, and insurance, as appear to have special interest for this grade.

Pupils who elect to take Mathematics 11 are very likely to be serious-minded about mathematics and interested in the subject from many viewpoints. Even though it is functional in nature like its predecessors, on the other hand it does give greater emphasis to the logical approaches and the techniques of mathematics. Those who elect Mathematics 11 expect a course that will prepare them mathematically to move in any direction their interest might lead them. This course is designed to fulfill such expectations.

Mathematics 12 purposes to contribute to the pupil's general education in effective citizenship: through an aroused interest and a deeper understanding of such topics as taxation, insurance, investments, installment buying, applications of mathematics to all kinds of measurements; through further development of reasoning with mathematics; and more attention to generalization. In short Mathematics 12 has for its goal functional competence for all who take it, with sufficient emphasis upon elected academic materials to enable a pupil, if he chooses to do so, to pursue studies in fields of science and technology.

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THE QUALITATIVE ANALYSIS SCHEME AND THE PERIODIC CLASSIFICATION

George A. Scherer
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Qualitative analysis often constitutes the laboratory work of the second half of the course in general chemistry. Presumably the reason for this arrangement is that the qualitative analysis furnishes laboratory illustrations of the descriptive inorganic chemistry taught in general chemistry. If qualitative analysis is to perform this function, it would be desirable for there to be a better integration between the classroom study of the elements and the qualitative analysis than is usually the case.

The number of facts regarding the common elements and their compounds is so vast that the student cannot remember them without some kind of classification to help him. The two classifications that are usually suggested to assist him are the periodic classification and the qualitative analysis scheme.

The periodic system enables the student of chemistry to understand and correlate a vast number of chemical and physical behaviors and even to deduce the properties of elements, which have not been studied, from a knowledge of properties of adjacent elements. This use of the periodic system enormously increases the effectiveness of a given amount of mental effort and the student should be encouraged to form the habit of using it constantly.

In a similar way the study of qualitative analysis enables a student to learn the maximum of inorganic chemistry that can be absorbed in the allotted time. For example after a student has become familiar with the qualitative analysis scheme, he knows which of the common sulfides are soluble in acid and which are not, whether the carbonates of the alkali metals or the alkaline earth elements are insoluble, what the color of the copper ammonia complex is, what elements form amphiprotic hydroxides, etc.

The periodic chart groups the elements on the basis of their electronic structures and the qualitative analysis scheme classifies them according to the reactions and properties of their ions which lend themselves to analytical separation and detection. Since the elements with similar electronic structures have similar reactions and properties, these two classifications should be related. This relationship is readily evident in the alkali metals and the alkaline earth elements but is less evident elsewhere.

Sears[1] suggested that this parallelism between the periodic table

[1] *J. Chem. Educ.*, *5*, 944, 1928.

and the qualitative arrangement could be made an effective teaching aid. It may be that the reason this idea has not been more widely used is that the conventional qualitative analysis scheme does not parallel very closely the periodic arrangement.

Separation of Classes.

<table>
<tr><td colspan="4">Solution of the sample.
Make the solution 0.3 N in H_3O^+ and saturate with H_2S.</td></tr>
<tr><td rowspan="3">HgS As_2S_3
Ag_2S Sb_2S_3
PbS SnS
Bi_2S_3 SnS_2
CuS
CdS

(Common cations of Periodic Groups IB, IIB, IVB, VB, minus zinc.)</td><td colspan="3">Ammonium Sulfide, Alkaline Earth and Alkali Classes.
Boil out H_2S. Neutralize with NH_3. Saturate with H_2S.</td></tr>
<tr><td rowspan="2">$Al(OH)_3$ FeS
$Cr(OH)_3$ ZnS
NiS
CoS
MnS
(Transitional elements of Period 4, omitting copper, and aluminum.)</td><td colspan="2">Alkaline Earth and Alkali Classes.
Evaporate. Add $(NH_4)_2CO_3$ and C_2H_5OH.</td></tr>
<tr><td>$BaCO_3$
$SrCO_3$
$CaCO_3$
$MgCO_3$
(Alkaline Earths)</td><td>Na^+
K^+

(Alkali Metals)</td></tr>
</table>

Analysis of Hydrogen Sulfide Class.

<table>
<tr><td colspan="6">HgS, Ag_2S, PbS, Bi_2S_3, CuS, CdS, As_2S_3, Sb_2S_3, SnS, SnS_2.
Digest in warm $(NH_4)_2S_x$.</td></tr>
<tr><td colspan="5">HgS, Ag_2S, PbS, Bi_2S_3, CuS, CdS.
Boil with HNO_3.</td><td rowspan="5">AsS_4^{---}
SbS_4^{---}
SnS_3^{---}</td></tr>
<tr><td rowspan="4">HgS</td><td colspan="4">Ag^+, Pb^{++}, Bi^{+++}, Cu^{++}, Cd^{++}.
Heat. Add NH_4Cl.</td></tr>
<tr><td rowspan="3">$AgCl$</td><td colspan="3">Pb^{++}, Bi^{+++}, Cu^{++}, Cd^{++}.
Add H_2SO_4. Evaporate.</td></tr>
<tr><td rowspan="2">$PbSO_4$</td><td colspan="2">Bi^{+++}, Cu^{++}, Cd^{++}.
Add excess NH_3.</td></tr>
<tr><td>$Bi(OH)_3$</td><td>Cu^{++}, Cd^{++}.</td></tr>
</table>

FIG. 1. Modified system of qualitative analysis.

Swift[2] has proposed the elimination of the so-called Silver Group from the usual system of qualitative analysis. This omits mercurous mercury from the scheme but "nearly all mercurous compounds are so insoluble as to require the action of oxidizing agents in their solution." It puts silver with the other elements whose sulfides are

[2] *A System of Chemical Analysis*, Prentice-Hall (1939) p. 197.

insoluble in acid. This modified system of analysis is shown in outline form in figure 1.

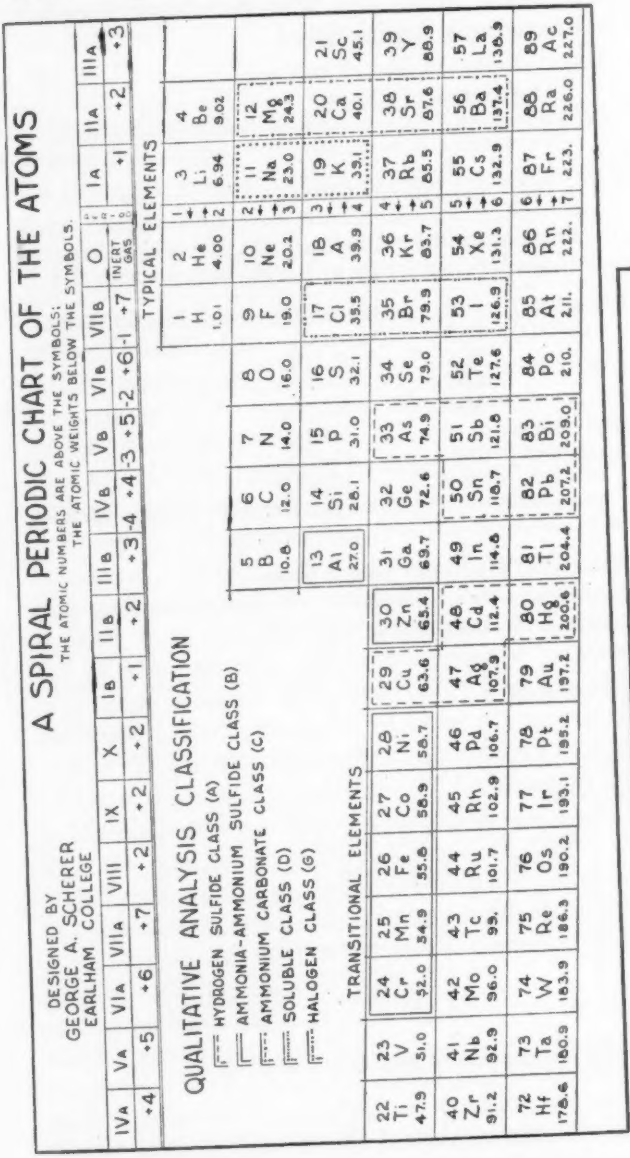

FIG. 2. Parallelism between the periodic table and the qualitative analysis scheme.

This modification of the conventional system of qualitative analysis produces a scheme of cation analysis which is clearly related to the spiral (or long) form of the periodic table as shown in figure 2.

Each of the resulting four cation classes[3] contains elements from certain groups or periods.

The common cations of Periodic Groups IB, IIB (omitting zinc), IVB and VB are the Hydrogen Sulfide class of the analytical scheme (those cations whose sulfides are precipitated from dilute acid solutions, namely, copper, silver, cadmium, mercury, tin, lead, arsenic, antimony and bismuth).

The Transitional Elements of Period 4 (omitting copper) and aluminum are the Ammonia-Ammonium Sulfide Class (those cations whose sulfides are not precipitated from dilute acid solutions, but whose hydroxides or sulfides are precipitated by ammonia and ammonium sulfide in the presence of ammonium salts, namely, chromium, manganese, iron, cobalt, nickel, zinc and aluminum).

The alkaline Earth Elements (Group IIA) are the Ammonium Carbonate Class (those cations whose hydroxides or sulfides are soluble in the presence of ammonium salts, but whose carbonates are insoluble in alcohol in the absence of ammonium chloride, namely, magnesium, calcium, strontium and barium).

The Alkali Metals (Group IA) are the Soluble Class (those cations whose hydroxides, sulfides and carbonates are soluble, namely sodium and potassium).

To these four classes of cations could be added one of the classes of anions, the halogens (Group VIIB), whose silver salts are insoluble namely, chlorine, bromine and iodine.

In teaching the chemistry of the elements, it seems reasonable to begin with those whose chemistry is the simplest and proceed to the more difficult. The periodic classification gives this kind of a sequence. The study can proceed from the alkali metals (Group IA) through the alkaline earth elements (Group IIA) and the Transitional Elements (such as chromium, manganese, iron, cobalt, nickel, etc.) to the less active metals of Groups IVB and VB.

If the order of the classes in the qualitative analysis scheme is reversed, it parallels this periodic sequence with but one or two exceptions. Engelder[4] has advocated that qualitative analysis should be presented in this reversed order because the student is better prepared to understand the complexities of the hydrogen sulfide class by beginning his study with the alkali metals and the alkaline earth metals and continuing with the oxidation states of iron, manganese and chromium; the amphiprotic hydroxides of aluminum, chromium and zinc; and the complex ions of nickel, cobalt and zinc.

[3] The term class is used in the analytical scheme and the term group is reserved for the periodic chart.

[4] *Semi-Micro Qualitative Analysis*, John Wiley and Sons (1947).

Periodic Group			Elements				Qualitative Class
IA	Li,	Na,	K,	Rb,	Cs,	Fa	Alkali Metals (D)
IIA	Be,	Mg,	Ca,	Sr,	Ba,	Ra	Alkaline Earths (C)
IIIA (and rare earths)			Sc,	Y,	La,	Ac	
IVA			Ti,	Zr,	Hf		
VA			V,	Nb,	Ta		
VIA			Cr,	Mo.	W		
VIIA			Mn,	Tc,	Re		
VIII			Fe,	Ru,	Os		
IX			Co,	Rh,	Ir		Ammonium Sulfide (B)
X			Ni,	Pd,	Pt		
IB			Cu,	Ag,	Au		
IIB			Zn,	Cd,	Hg		
IIIB	(B)	Al,	Ga,	In,	Tl		Hydrogen Sulfide (A)
IVB	(C,	Si),	Ge,	Sn,	Pb		
VB	(N,	P,	As,	Sb,	Bi		
VIB	(O,	S,	Se,	Te),	Po		
VIIB	(H, F,	Cl,	Br,	I,	At)		Halogens (G)
O	(He, Ne,	A,	Kr,	Xe,	Rn)		

FIG. 3. Course of study of the elements following the order of the periodic groups and correlated with the qualitative analysis classification

Figure 3 shows how such a course would be organized. The properties studied in the analysis as well as those expected from the periodic law are naturally and easily brought together. The classroom and laboratory work follow the same logical and natural sequence indicated in the periodic law and illustrated by the qualitative analysis.

SUNFLOWER POISON

To all appearances the plant world seems a peaceful one, but scientists at the University of Wisconsin have found that some plant species literally poison their neighbors.

Plant-world counterparts of the famous poisoning Borgias of human history are the prairie sunflowers, Profs. John T. Curtis and Grant Cottam, University botanists, report.

The sunflowers not only poison such innocent neighbors as grasses and wild flowering plants, but they poison one another. The reason sunflowers in the center of a large perennial plot seldom do as well as those on the edge is that they are completely surrounded with dangerous relatives.

There is, of course, a sober scientific explanation for these murderous antics. It is simply that the sunflower and a few other plant species produce chemicals which are liberated into the soil when the decay of deadroots takes place. There chemicals inhibit growth.

Professors Curtis and Cottam, conducting the experimental work in the University of Wisconsin arboretum, found that the poisonous substance does not maintain a toxic condition in the soil from one year to the next but must do its lethal work in the spring.

THE SCIENCE LECTURE IN THE HIGH SCHOOL ASSEMBLY

III. THE CATALYSTS OF THE HUMAN BODY

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Today I am about to ask you some questions, but please do not be alarmed. I shall not only ask the questions—I shall also try to answer them. (I do not mind if you complete the turning of the tables on me and give me a grade for the quality of my answers!)

My questions are as follows:

1. Did you know that a negro baby is born practically white?
2. What prevents you from bleeding to death, once you have been cut?
3. Why is Vitamin B so important?
4. How does the body prevent itself from eating up or digesting its own stomach?
5. What kind of fuel and furnace is used by a foot-ball player's "powerhouse"?
6. How is it that in spite of all the acid-forming food which we eat a person's blood does not become acid and cause his death?

Now for the answers. One might almost say that it is "done with mirrors," for the chemical changes involved in these activities of the body do not use up or consume the chemicals which cause the process to begin. In theory then, since they are not diminished by the body, they could go on forever.

Many of you have performed an experiment in the chemical laboratory in which you found that when potassium chlorate is heated strongly it grudgingly gives up oxygen gas, but when a pinch of manganese dioxide is added to the potassium chlorate, oxygen gas comes off rapidly and at a much lower temperature. We say that manganese dioxide is a catalyst and we define the term catalyst by saying that it is a substance which brings about a chemical change in some other substance, but remains, itself, unchanged.

The human body has many catalysts distributed through its parts. These catalysts are called enzymes. You can tell some enzymes by their names, because the more recently discovered ones have names ending in "ase"—for example "dehydrogenase" is an enzyme which removes hydrogen from some compounds.

Enzymes are like specialists, each enzyme doing only one kind of job for the human body. For example dehydrogenase will remove only hydrogen. In order that the enzyme may carry out only its own specialty, it consists of two parts, namely, a part called an "apo-enzyme" and another part called a "co-enzyme." The "apo-enzyme" is like the artillery officer, who directs his battery's fire, while the "co-enzyme" fires the cannon. How this directing of fire takes place

is not known, but we believe we are beginning to understand how the actual firing takes place. Let us take dehydrogenase as an example again. Most of you know that all matter contains electrons. These are negative particles of electricity. When an element loses its electrons it becomes charged positively and will be attracted to another element charged negatively. Dehydrogenase is a specialist at seeking two hydrogen atoms from a molecule of a carbohydrate or a fat, pulling their electrons from the hydrogen atoms and shifting them toward an oxygen atom. The oxygen atom is now made negative by the presence of the two electrons from the hydrogen atoms, while the hydrogen atoms are left positive by the loss of these electrons. This causes hydrogen and oxygen to attract each other and unite, leaving the fat with less hydrogen, hence the name "dehydrogenase."

Forms of living tissue, other than that of the human body also contain their innumerable enzymes or catalysts. I shall mention three—"oxydase" "luminase" and "bromelin." An apple which has been bitten into turns brown due to oxidation. This is brought about by oxidase present in the apple cells. As soon as air is admitted into the apple by the person who takes a bite out of it the oxydase starts the process of adding atmospheric oxygen to the apple tissue. This is called "oxidation" and results in a product which has a brown color. Hence the apple turns brown. The second enzyme mentioned—"luminase"—is the catalyst which helps to produce the luminescence of the "fire-fly" or "lightning bug." "Bromelin" the last of the group, is found in the pineapple, and has the power of acting upon protein. That is why pineapple is used by some cooks to soften a tough cut of meat.

I. Now to explain why a colored baby becomes dark-skinned within a few days after birth. The skin contains cells called melenoblasts. These cells contain a catalyst. The human skin also contains a chemical compound (3,4, dihydroxy-phenylalanine). Ultraviolet light, present in sunlight, causes the formation of this compound which can be changed by the catalyst into a new compound called melanin, which is dark in color. When a colored baby is born it has very little melanin in its skin because it has not had time to produce much of the compound. Under the influence of ultraviolet light much of this compound is formed in the skin, during the first days of life. This is changed by the catalyst into melanin and the baby's skin darkens.

DIAGRAM I

Dopase (catalyst present in meleno-blast of skin)	+	Dopa (3,4, dihydroxy-phenylalanine, formed by action of ultra-violet light of sun upon skin)	→	Melanin (dark pigment of skin)

II. Let us attempt an answer to question number two—What prevents you from bleeding to death, once you have been cut?

You will at once say, "The formation of a blood clot—any fool knows that!" But what, pray, causes the blood to clot?

When a person is cut somewhere, the cut tissues pour out the enzyme called "thrombokinase" which it contains. Thrombokinase is present in the cells which cover all body surfaces and it is also present in the white cells and platelets of the blood, so that it would be difficult indeed to imagine how a person could be cut anywhere without starting immediately to pour out the catalyst "thrombokinase." Now calcium is also present in the blood, and thrombokinase and calcium get together and act upon a third kind of substance present in the blood called "prothrombin," changing it into a new substance called "thrombin." The blood contains a fourth substance called "fibrinogen." The thrombin which we just learned was produced by the catalytic action of thrombokinase acting upon prothrombin has the power of changing "fibrinogen" into "fibrin." "Fibrin" forms a network foundation and traps blood platelets, and red and white corpuscles, thus forming a clot.

DIAGRAM II

1. Thrombokinase (present in the cells of skin and poured out when cells are broken—acts as a catalyst) + Calcium (present in blood) + Prothrombin (present in blood) → Thrombin

2. Thrombin (catalyst) + Fibrinogen (present in blood) → Fibrin

3. Fibrin + blood platelets + red and white corpuscles → a blood clot

4. Thrombokinase (from injured skin, etc.) + Much Anti-thrombokinase (present in blood—acts as traffic officer) → no blood clot

5. Much Thrombokinase (pours out when skin is cut) + Anti-thrombokinase (normal amount) → Clot (anti-thrombokinase put to rout)

A very remarkable thing about blood clot formation is that thrombokinase, the compound which starts the entire process, is present in the blood to begin with, but is prevented from starting the process of clotting by the presence of a super-catalyst, or anti-catalyst—a sort of traffic policeman of catalysts. This is called "anti-thrombokinase." But in a normal human being just after an injury so much more thrombokinase is poured out by the broken cells that the traffic officer is lost in the rush of traffic. (It is swamped, as it were.)

You have heard of bleeders, or hemo-philiacs—people who bleed to

death from the most minor wound—for example the members of the Royal House of Hapsburg. Such people suffer from too much anti-thrombokinase in their bodies. This prevents blood-clot formation and allows a person to bleed to death.

III. The next question is, "Why is Vitamin B so important?"

Vitamin B contains many compounds, among them B_1, or thiamine, B_2, or riboflavin, and B_3, or nicotinic acid. Thiamine plays several roles in the body, among them being the fact that the body changes some of it into a catalyst called "cocarboxylase." When the body is breaking down glucose or grape sugar by means of oxygen obtained during respiration, the cocarboxylase removes carbon dioxide from the glucose, thus helping the body produce energy which it uses for muscular activity. Let it be sufficient here to point out that the constituents of Vitamin B complex are needed by the body, because from these the body makes certain enzymes, i.e. the thiamine is changed to cocarboxylase, while riboflavin and nicotinic acid are also used by the body to make enzymes "co-enzymes 1 & 2." These also work upon the glucose, but remove hydrogen instead of carbon dioxide (as does cocarboxylase) and convert it into water, energy again being released.

A helpful role is played by another catalyst found in the cytochromes (the iron compounds in all cells). You will remember that dehydrogenase removes hydrogen. One of the cytochromes removes molecules of oxygen from the blood and causes them to unite with the hydrogen removed by dehydrogenase. Water is thereby formed, which is a good thing, because waste hydrogen could not be eliminated by the body easily in any other way. At the same time energy is produced by this burning of hydrogen to water. The water thus formed is also beneficial, since it can dissolve other harmful waste products and carry them out of the body. About one-seventh of the water which leaves the system daily is manufactured by the body in this manner.

DIAGRAM III

1. Vitamin B_1 changed by body to Cocarboxylase (a catalyst)

2. Cocarboxylase+Grape sugar→Carbon dioxide+other products+energy

3. Vitamin B_2+Vitamin B_3 changed by body to "co-enzymes 1 & 2"

4. Co-enzymes 1 & 2+Grape sugar→Hydrogen+other products

5. Hydrogen (removed by co-enzymes 1 & 2) +Oxygen (from blood) +Cytochromes of cells (catalyst) +Water+56,000 calories of heat

IV. How is the stomach prevented from being digested by the pepsin of its own gastric juice?

To digest the food the stomach needs gastric juice. Gastric juice contains pepsinogen (a catalyst) and hydrochloric acid. Pepsinogen cannot act upon protein and digest it. It must be changed into pepsin, also a catalyst, which can act upon protein. To change pepsinogen into pepsin, hydrochloric acid is needed. But, hydrochloric acid does not flow in quantity into the stomach until food arrives there. Hence in the absence of food there is insufficient hydrochloric acid to change pepsinogen into pepsin and there is therefore no pepsin to act upon the stomach.

DIAGRAM IV

1. Gastric juice + flesh of stomach → no action, because little or no pepsin.
2. Food in stomach stimulates the flow of Hydrochloric acid
3. Hydrochloric acid + Pepsinogen of Gastric juice → Pepsin (catalyst) (digestion of protein can now take place)

V. What kind of fuel and furnace is used by a foot-ball player's "powerhouse"? There is an enzyme in the body called "phosphorylase." This catalyst causes phosphate radicals or ions, which are present all over the body to add on to glucose, after its formation from glycogen. The compound formed is called glucose phosphate. Since glycogen is a very large molecule its breakdown to glucose gives off energy, which is stored in glucose phosphate. This storage is done in what is known as "high energy phosphate bonds" which are nothing more than a certain arrangement of electrons. Because it takes energy to produce this special electronic arrangement (from the breakdown of glycogen to glucose) this high energy bond possesses and can therefore release its energy when glucose phosphate breaks down. As this breakdown of glucose phosphate is taking place constantly, giving off energy, there must be a means of storing this energy for later use. The "tank" for storing this energy is a compound called "adenosine." Three phosphate radicals, from glucose phosphate, each with its storage of great energy, attach themselves to "adenosine" and the compound formed, called "adenosine triphosphate" (abbreviated A.T.P.) containing this energy, is stored away for muscle use. When muscular activity requires energy it obtains it by removal of phosphate radicals or ions from A.T.P., which has stored up these high energy bonds. First the triphosphate (3 phosphates) loses one phosphate to form adenosine diphosphate (2 phosphates) and in so doing releases energy. Next one more phosphate is lost, producing monophosphate (1 phosphate) and more energy. The adenosine monophosphate may then be used all over again to store more energy by changing back again to the diphosphate and triphosphate, the energy re-

quired to produce these coming from the glucose phosphate as was originally the case.

DIAGRAM V

1. Phosphorylase+Phosphate+energy obtained from breakdown→Glucose phosphate (much energy)
   (a catalyst) of glycogen to glucose

2. Glucose phosphate→Phosphate plus other products
   (high energy bond)

3. Three phosphate groups+Adenosine → Adenosine triphosphate (stored away in all cells)
   (containing high energy bonds, an electronic arrangement of a special sort)

4. Adenosine triphosphate minus one phosphate→Adenosine diphosphate+energy for muscles
   (during muscular activity)

5. Adenosine diphosphate minus one phosphate→Adenosine monophosphate +energy for muscles
   (during muscular activity)

VI. How is it that in spite of all the acid-forming food which we eat, a person's blood does not become acid and cause his death?

The kidneys control the degree of acidity of the body (called pH) by controlling the excretion or retention of sodium. If the blood is very much on the alkaline side (high pH), more sodium is excreted by the kidneys. If the blood is not so much on the alkaline side (low pH), sodium is retained. Now in this less alkaline state the kidneys would like to have even more sodium, but since sodium is an element and cannot be made by the body, the next best thing is to make a substitute for it. The body has the power to make this substitute, namely ammonia, which it can produce from the nitrogen and hydrogen of the amino acids gotten from the foods we eat. In order to have this control the kidney cells have a catalyst known as "aminoxydase." This enzyme acts as follows: When the blood is moving toward the acid side, aminoxydase causes the formation of ammonia in the kidney cells and substitutes this ammonia in place of sodium in the chemical compounds present in the urine. Ammonia being a weaker alkali than sodium, the urine becomes less alkaline, but the blood more alkaline. (The sodium compounds having been retained, the blood remains on the alkaline side.) Thus the acids present in our foods do not store up in the blood.

DIAGRAM VI

When the blood becomes less alkaline:
Aminoxydase+Amino acid→Ammonium groups or ions (sodium ions retained causing increased alkalinity)
(in cells of kidneys) (excreted)

I have tried to give you some idea of how important and how

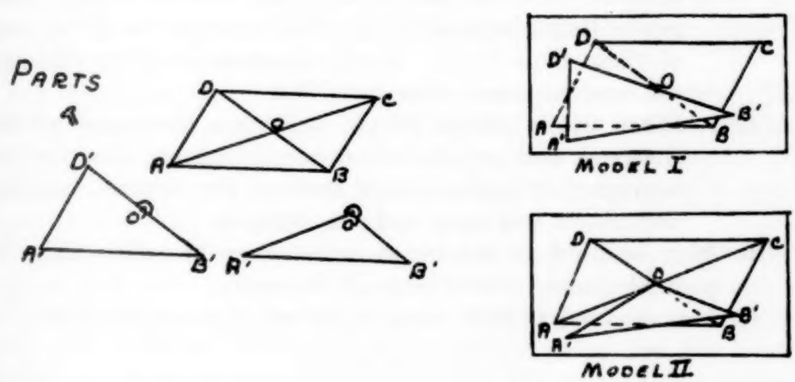
numerous are the catalysts of the human body. Many new ideas and words have been presented and I hope you will remember some of them. Even if you do not, you may have been impressed by the extreme orderliness of the human body and the highly specialized work of its catalysts.

MODELS FOR INTRODUCING PARALLELOGRAMS

ETHEL L. GROVE
1814 Tuxedo Avenue, Parma, Ohio

I. Construction (Two models)

A. Materials
1. Cardboard
2. India ink
3. Speedball pen
4. Paper fastener



B. Steps in Construction
1. Cut two cardboard rectangles $15'' \times 20''$.
2. Construct $\square$ *ABCD* on each and outline with ink.
3. Draw *DB* on Model I and *DB* and *AC* on Model II.
4. Construct $\triangle A'B'D'$ on other cardboard congruent to $\triangle ABD$ on Model I.
5. Outline $\triangle A'B'D'$ in ink and cut out leaving tab at O' on $D'B'$.
6. Place $\triangle A'B'D'$ on $\triangle ABD$ on Model I and attach with paper fastener through O'.
7. Construct $\triangle A'B'O'$ on other cardboard.
8. Outline and cut out with tab at O'.

9. Place on $\triangle ABO$ on Model II and attach with fastener through O'.

II. Use

A. Pupil Experimentation

1. Place on bulletin board the day before introducing parallelograms.
2. Allow pupils extra time before class to rotate superimposed triangles and to discuss their observations informally. Then go on with that day's work without reference to models or parallelograms.
3. Allow time next day for those who did not investigate on first day. Then open formal discussion of parallelograms.
4. Ask pupils to suggest relationships they believe to be true from observation of model. Write these on board.
5. Take these relationships one by one and have pupils suggest proofs for them from facts already known about congruent triangles and parallel lines.
6. If some of these relationships are not true they must prove them impossible. If they attempt to prove any of these facts in the wrong sequence let them discover the need to prove other facts first.
7. When list is completed you will have developed all the theorems and corollaries on parallelograms given in the average text and probably most of the original exercises and pupils will have had fun doing it.

B. May be used for teacher demonstration of relationships in parallelograms instead of pupil discovery.

C. May be used as flash cards in review of parallelograms.

GERMANIUM FOUND IN CAPITAL CITY

The richest deposit of the vital war material, germanium, yet found in the United States has been discovered in the earth of parks, playgrounds and other locations here in the nation's capital.

This vein of treasure from the Patuxent formation runs from Baltimore to Richmond, U. S. Geological Survey scientists find.

The deposits contain up to 6% germanium. The highest content previously reported, in the mineral germanite in Africa, was 10%. The District of Columbia deposits also contain vanadium, chromium and gallium.

Discovery of the new germanium deposits is reported by Miss Taisia Stadnichenko, K. J. Murata and J. M. Axelrod in the journal, *Science*.

The deposits are in the lignite remains of Cupressinoxylon wardi, a tree somewhat similar to the coniferous family, from the Cretaceous era, about 100,000,000 years ago.

Germanium is particularly valuable for electronic instruments. It is a semiconductor, standing half-way between materials that are conductors and those that are insulators.

TRAINING ELEMENTARY TEACHERS WITH A GENERAL SCIENCE SPECIALTY

WALTER A. THURBER
Cortland State Teachers College, Cortland, N. Y.

Administrators of New York State public schools have for years been anxious to strengthen the science program in the elementary schools. They have fostered workshops, they have encouraged teachers to take science courses, they have issued directives as a last resort.

Two years ago the Elementary Principals Association conducted an elaborate survey of elementary science in the state and published a year book designed to stimulate the program. In the foreword, Dr. William Young, Director of Elementary Education, in the State Education Department, stated, "Next to reading, science is the most important subject," thus giving the blessings of the Education Department to the movement.

In 1938 the State Education Department issued what was perhaps the richest and most elaborate elementary science syllabus in the country. This has been issued in large numbers and has been revised and reprinted several times.

But despite so much assistance and so much encouragement, the elementary science program in New York State is far from successful. Without administrative pressure most teachers ignore science. If science teaching is demanded, teachers depend upon a set of textbooks and conduct reading lessons in the name of science.

Probably the best spontaneous science teaching is done by the older teachers who were trained in Nature Study. Nature Study emphasized the study of familiar objects and provided teaching methods along with content. However, about twenty years ago the State Teachers Colleges of New York abandoned Nature Study for formal science courses; since then the ranks of Nature Study trained teachers have thinned considerably.

There is good science teaching in a few New York State schools that have elementary science supervisors. Most schools, however, cannot afford special subject supervisors.

A few schools have departmentalized their elementary science program in an effort to have good teaching. But special teachers cannot possibly provide as rich a program as can the teacher who is with the pupils all day, and so the outcome is not entirely happy.

Elementary science fails in New York State largely because of the teachers. Most teachers are afraid of science. They think of science as something formal, difficult and remote. They have no knowledge of how to teach science to children.

However, most elementary teachers can become excited about science when they are shown what to present to children and how to present it. This writer has been working with some three hundred teachers in several systems. It is always surprising to see how rapidly an unfavorable attitude towards elementary science can be replaced with enthusiasm.

The Science Department of Cortland State Teachers College for some time discussed these problems of elementary science teaching. Revision of the college science program did not accomplish any marked change, because only twelve hours of science are required, and these are in the freshman and sophomore years, before students are conscious of professional needs.

Three years ago the Science Department asked permission to introduce a general science major for a limited number of selected students. The president of the college, Dr. Donnal V. Smith and the then Assistant Commissioner for Teacher Education, Dr. Hermann Cooper, now Executive Dean of the new State University, studied the proposal and gave their approval.

It is to report on the science major program and some of its early results that this article is written.

Purpose of the Program

As the Science Department planned the program it visualized a dual character to the training of its undergraduates. First, these young men and women should be trained as excellent general teachers in grades one through eight. This in order that they may better understand children and the general education program. Secondly, they should have a sound basic science background, a knowledge of the special techniques used in science teaching, and practice in the teaching of science.

Such training would permit graduates to take two types of positions. Some would be expected to take positions as general education teachers in the grades, there to put on outstanding science programs and serve as examples to other teachers. Individuals with higher ambitions might give help to other teachers, and with additional training head for supervisory positions.

It was expected that the remainder would take positions in departmentalized schools where there is a serious need for general science teachers who see science as part of an overall program, and not as a training ground for the specialized sciences. In many systems such graduates might help the elementary teachers with the elementary science program and with training aim for supervisory work.

Principles Underlying the Program

It must be emphasized first of all that our students are trained as general education teachers. On top of their general training, they are given the science specialty. The last thing to be desired would be a teacher who feels set aside from other teachers, with nothing in common, and no desires to make sacrifices for the general welfare of pupils.

The professional attitude of the students has been deemed of special importance. The program is planned to encourage students to think of themselves as teachers from the beginning of their training. And every opportunity is used to awaken the students to the wider responsibilities of teachers.

Because these teachers will be general science teachers in the true sense of the word, their science training must be broad. Even if there were sufficient time available, students would not be permitted to specialize in any particular science.

Because of the experimental nature of the program, and the added load on students and staff, it was felt that the number of students should be severely limited to those who show special interest and ability.

In so far as possible it is felt that students with science majors should be kept in special sections for their science courses. This in order that the subject matter can be somewhat professionalized, at least in presentation.

The Program

Following is the complete science major program and a summary of the hours:

Elementary Education With Science Major

Freshman Year

First Semester	Hours	Second Semester	Hours
Child Development	3	Child Development	3
Composition, Written	3	Composition, Oral	3
Personal Health	3	Community Health	2
Backgrounds of Music Literature	2	*Music Essentials	2
Art Essentials	2	Introduction to Math	3
*Introduction to Physical Science *Earth Science	3	Biology	3
Physical Education Activities	1	Physical Education Activities	1
	17		17

Sophomore Year

First Semester		Second Semester	
Child and Curriculum	4	Child and Curriculum	3
*Composition (Written)	3	*Composition, Oral	3
American History I	3	American History II	3
*Mathematics	3	Geography I	3
Human Biology	3	Physics I	3
Physical Education Activities	1	Chemistry I	3
	17		18

Junior Year

First Semester		Second Semester	
Ed. Organization and Administration for Classroom Teachers	2	Practice Teaching	15
Introduction to Literature	3	9 weeks General Elementary	
Physical Education Theory	2	9 weeks Science	
Crafts	2		
Biology II	3		
Physics II	3		
Physical Education Activities	1		
	16		

Senior Year

First Semester		Second Semester	
Education Seminar	3	Science Education Seminar	3
*Literature	3	*Social Studies	3
*English	3	Free Elective	3
*Social Studies	3	*Art Elective	2
*Science	3	Chemistry II	3
		Sociology	3
	15		17

Outdoor Science in Camp (3 weeks summer)	4 hours
Science Seminar—weekly	no credit

* Elective by Advisement.

Summarized the Program is as follows:

	Hours			Hours
Education	36	Science		30
Mathematics	6	(Human Biology)	3	
English	21	(Gen. Biology)	6	
Social Studies	18	(Physics)	6	
Fine Arts	11	(Chemistry)	6	
Elective	3	(Earth Science)	3	
Health and Physical Education		(Science Elec.)	3	
		(Outdoor Science in Camp)	3	
				136

Science and Health Teaching Methods (3 hours) and Science Education Seminar (3 hours) are part of the 30 hours in education. One period of practice teaching (ten weeks) is in General Science, usually seventh and eighth grade; the other period is in Elementary Education, usually lower grades.

THE OPERATION OF THE PROGRAM

Students who are interested meet first with the director of the science major program and are told about the nature of the program, its philosophies and the possible futures to be expected. After this those who wish apply for consideration. No one is taken until he has been at Cortland one semester.

High school records, entrance tests and college records are scanned. Instructors who have worked closely with the students are interviewed. High scholarship is not of first importance, but students with college failures are not considered further and a low grade is looked upon with disfavor. Recommendations of the English Department and the Education Department are given special weight.

Following the gathering of data each candidate is interviewed by the Science Department. The Science Department then selects the more impressive students. No predetermined number is chosen; instead the caliber of the students is the limiting factor.

Science major students are brought together and made acquainted through the weekly seminar. Each student is expected to attend the seminar for at least four semesters.

The seminar is designed to give a broader view of science teaching than course work can do. Members of the department describe their graduate research, outside speakers are brought in, and science films are previewed. And, as opportunities arise, the entire group is taken to science teachers meetings and to science fairs.

Most of the science major program is fixed, but some advice on scheduling must be given. The English program is being given increased attention because of the problems that have shown up during cadet teaching. The sophomore English schedule is flexible so that weaknesses appearing during the freshman year may be corrected, or if sufficient mastery of the language is evident, that special interests may be followed.

The Science Methods class involves a certain amount of practical experience, such as duplicating, operating visual aids machines, setting up demonstrations and experiments, and the making of charts and models. It includes some basic theory of lesson planning and some experience with various types of units. It also involves actual participation, including teaching in the College Demonstration School.

Half of the cadet teaching is usually done in the lower grades as straight elementary teachers. The other half is done in seventh and eighth grade science, with special opportunities in lower grade science when the situation so permits. All cadet teaching is done in public schools near Cortland.

In the senior year, Education seminars permit students to remedy weaknesses and to follow up interests. Opportunity for more teaching

is provided in the local schools. Specialists help with language difficulties, with reading problems and the like. Many of the students spend a great deal of time building up files of teaching suggestions and supplementary materials.

Lastly, comes the problem of placement. Here we try to fit individuals and positions according to interests and abilities on the one hand and facilities and type of challenge on the other.

Some Comments on the Program

The method of selection and the emphasis on professional attitude has resulted in an outstanding group of future teachers. Other members of the college faculty have commented on their eagerness and their enthusiasm. During cadet teaching, school administrators have been lavish with praise, sometimes even offering positions to juniors to be taken on graduation. And at science teacher conferences, experienced science teachers remark again and again on the fine spirit of the Cortland students.

However, we have made a few mistakes. We have been compelled to drop a few people from the program, usually because of instability. And at least two young men, refused because of poor scholarship records during their freshmen years, have turned out to be excellent teachers.

Thus far we have admitted about half of those who apply, but as knowledge of the requirements becomes better known, fewer ineligibles apply. Unfortunately, some very desirable individuals fail to apply because of a sense of inadequacy. The department must find ways of reaching these latter.

The science subject matter background, although not extensive, is broad enough to serve, except for one weakness. There must be more field work than is now given, both in the physical and biological sciences. Perhaps we shall require at least one field course in the future.

The camping course will be offered next summer for the first time. It will consist partly of adventure camping—living out-of-doors, canoeing overnights, mountain climbing, special camp cookery, survival crafts—and partly of nature study based on materials of interest in camping.

The placing of cadet teachers is a very real problem because we now have more students than there are good general science teachers within a reasonable radius of Cortland. Few teachers like more than two cadets a year. Thus far we have made out by placing some of our strongest people in less desirable situations but this is not satisfactory. We have hope, however, because we are placing some of our graduates

in nearby schools; in a year or two we can use them in our training program.

Both Science Methods Class and the Science Education Seminar suffer from lack of room facilities. We need library and reference facilities, files for looseleaf materials and for bulletins, and a "museum" of science teaching devices. We hope that in the near future such facilities will be provided.

Placement of teachers at this time is no problem. Many administrators who have had our cadets have come to Cortland for science teachers. Some have even made positions for individuals they liked.

This year the seniors put out a little brochure listing their qualifications. We have received many calls on the strength of this device.

Our first graduate, a young man who came back for the science major program after completing his degree, is now an elementary science supervisor in a suburban system. Others are teaching junior high general science and helping with lower grade science. Two are teaching science in the first six years on the departmentalized basis. They are placed at a figure well above the minimum, and considerably higher than the average for beginning teachers. Thus far, all have received between $2600 and $3200 depending upon the type of community, with suburban areas higher.

We at Cortland are very proud of our program. There are many details to improve but we feel that basically the program is very sound. We hope to substantially contribute to the cause of good elementary science teaching through our graduates.

A NOTE ON TRANSFORMATION OF COORDINATES

C. B. Read and Ferna Wrestler
University of Wichita

In transforming an equation from rectangular to polar coordinates the beginning student may, if not warned, disregard a factor, and obtain a locus lacking an isolated point. For example, the equation $x^2+y^2=x^3$ has the origin as an isolated point. If, after transforming to the form $r^2=r^3\cos^3\theta$, the factor r^2 is neglected, the resulting polar equation $r=\sec^3\theta$ does not contain this isolated point. Several texts call attention to this difficulty.

Examination of more than a dozen elementary texts fails to reveal any discussion of the possibility of a transformation yielding a locus containing a point not present in the locus of the original equation. Consider the locus $r=\sec^3\theta$ clearly not containing the pole. Substituting $r=\sqrt{x^2+y^2}$ and using $x=r\cos\theta$, from which $\sec\theta=r/x$, one obtains $x^3\sqrt{x^2+y^2}=(x^2+y^2)^{3/2}$ or $x^3=x^2+y^2$ which clearly has the origin as an isolated point. It may be argued that the relation $\sec\theta=r/x$ is not valid for the pole—in any event it would seem that some caution might be given to the student that the customary transformation equations do not always yield equivalent loci.

CONSERVATION-EDUCATION AT THE SECONDARY LEVEL

J. Russell Storey
Oak Park High School, Oak Park, Illinois

I do not need to emphasize to you, as educators, the important place that conservation should have in the curriculum of every school. All of us know that only through a well-planned and effective conservation-education program may we preserve and protect our heritage of natural resources—a heritage which means the difference between happiness and wealth on one hand and distress and poverty on the other.

We as teachers are pretty well agreed on the importance of and the need for conservation education but we are often perplexed as to the most effective means of presenting these principles to our boys and girls. The purpose of this panel discussion is to help us to better understand ways in which to present to our students the fundamental principles of conservation.

While the methods used by the individual teacher may vary according to the size of the school and the type of locality, certain general procedures and basic principles may be taught in all situations. I am referring to the ecological approach or point of view of plant-animal communities and man's relationship to his environment. In this approach plant and animal communities are studied in all their physical and biological relationships to each other. We study how plant-animal communities develop, how soil, climate, and moisture affect these communities and how man destroys and may restore these communities. We see the slow building necessary in forests and soils. They just don't happen. The student should know something about the principles which brought them about and the time and methods which are necessary to restore them if they are destroyed by man.

In our biology course at Oak Park High School we have a unit in which conservation is presented from the point of view of plant-animal communities. The student becomes acquainted with the distribution of plants and animals. He learns about the factors which affect this distribution; the various barriers to distribution and adaptations of plants and animals which facilitate this distribution. He becomes cognizant of the differences in plants and animals, and their adaptations which make various habitats on land and in the water possible. He discovers that there are plant and animal communities as well as the human community in which he lives. These communities must develop just as a human community develops from a pioneer stage to a climax or mature stage.

Succession is emphasized. In most localities outstanding evidences of succession may be noted—whether it is the sand dune succession so familiar to us who teach in this locality; water succession in a small lake or pond; succession on a rocky ledge; or succession in a strip mine area. Pioneer and climax stages in plants and animals are studied together with changes between these stages and factors which bring about these stages. The student learns that each stage prepares the way for the next. What better examples can we show him of the dependence of living things upon each other?

He also learns of the inter-dependence of plants and animals in climax communities, of animal dependence on plants for food and shelter, of plant dependence upon animals for soil enrichment, pollination of flowers and dispersal of seeds and fruits. He studies the relationships which exist between animals. He becomes appreciative of the relationships of light and shade, moisture, support, space and protection which exist between plants. He discovers that no living thing can exist alone and that disturbances in the natural balance of plant and animal communities may cause the plant and animal community to cease to exist.

With this foundation the student is then taught the relationships which exist between the human community and plant and animal communities. He learns how man disturbs the balance of nature by soil erosion, deforestation, fire, water pollution and wild life destruction and how man may bring about restoration by soil conservation practices, reforestation, fire control, proper disposal of factory and city wastes, and wildlife protection. He becomes aware of the need for and the importance of various community, state and national agencies and conservation projects.

We also impress upon the student that conservation principles should be applied to human resources. This includes man's relationship to disease, desirable housing, sanitation, proper lighting and recreational facilities.

Just how successful this unit or any unit in conservation can be depends to a great extent upon the individual teacher. Methods used would also depend to some extent upon the size of the school and upon the type of locality. May I offer a few suggestions which I feel would be useful in most situations and in most courses which teach conservation. In the first place our training and experiences have taught us that active participation on the part of pupils is one of our best teaching methods. The ideal way to teach conservation is to have the pupils do some specific conservation work. This is easy in small, rural communities and is not completely out of the picture in our city areas. Unless these boys and girls do something in an active sort of way our work in conservation may become so stereotyped—so

far removed from their daily lives that it may mean little to them except a unit of work to be covered and a test to be passed.

In order to bring about as much active participation as possible, the project method of teaching may be used. It would be wonderful if every pupil could plant a tree or contribute in an active way to some conservation project being carried on in the community. These projects both individual and group could vary from simple ones carried on in the home and in the school to more complex ones on a larger community scale. Simple projects in the home might take the form of checking good health habits; proper care of clothing; and the conservation of electrical and water supplies. Among projects which could be carried on in the school are those pertaining to safety; cleanliness of the buildings and beautification of the school grounds. I feel that we would be getting somewhere in conservation education if each pupil in our courses could do one small thing that would contribute to an improvement in conservation practices in his community. I hope that the discussion which follows these talks will bring out some of the actual things your classes do in conservation work, for only in this way can we all profit by your methods and experiences.

For those who feel that time and circumstances would not permit this sort of approach at the high school level there are activities to be carried on and principles to be taught in all units of work where conservation is studied. Seeing is much better than just being told or reading about it in a book. For this reason we are all agreed on the value of the field trip. By means of well planned and supervised field trips—some in the neighborhood of his own school, others at a distance—the student should be shown the need for conservation practices in his own community. He should see first hand the importance of and the need for such projects as parks and forests, wildlife preserves and soil conservation practices. Soil means very little to the average student unless he can be shown the relationship which exists between the types of soil and his own food supply. As a result of this technique in teaching should come a realization of how he might have an active part in these conservation projects.

The student should know about what is happening to the nation's lands and to the resources which rightfully belong to him. Surveys of the effect of unwise conservation practices upon the water supply, especially, in relationship to wells, can be made in most areas. Other surveys could include causes and effects of stream pollution which has become an outrage to conservation in many areas of the country. As a result of this activity should come a desire on the part of the pupil for active participation in the study and passage of desirable conservation legislation.

All conservation education should teach the importance of the work of such government agencies as the Soil Conservation Service and the National Park Service. The student must be informed of the need of these agencies for funds and the permission to carry on effective educational activities. William Vogt in his fine book, "Road to Survival," which I recommend to all of you for reading and study, makes this statement. "The Departments of Agriculture and Interior work on the land and with the people who work on the land. It is high time they also began to work with the scores of millions to whom the land is merely a place where one spends vacations."

Boys and girls should be taught how to handle matches, cigarettes and campfires. They are and will be the ones from our cities who spend their vacations in the country. Without the consciousness which results from this teaching they are and may be the ones who burn down our forests.

We should also impress the student with the importance of conserving our mineral resources which are being depleted through ignorance, war and selfish greed. Authorities tell us that on the basis of the average annual rate of consumption from 1935 to 1945 we have about 76 years supply of iron ore, 19 years supply of copper, 10 years supply of lead, 15 years supply of petroleum and natural gas. A similar situation exists in regard to other important minerals.

In order to teach these ideas effectively all suitable educational media should be used. This includes the use of posters, films, pamphlets, radio broadcasts and newspapers. Community organizations such as Boy and Girl Scouts, 4-H clubs, service clubs, P.T.A. associations should cooperate in every way possible with the schools in the presentation of effective conservation education. These organizations are usually eager to help if the proper incentive and cooperation can be given by the schools and by the teachers engaged in this work.

Many examples can be given of the fine cooperation which exists between community organizations and the schools in the teaching of conservation. I would like to mention as an example of such cooperation our own Morton Arboretum which makes it possible for those of us who teach in this area to study first hand the principles which we present to our students. Here also boys and girls may participate in a conservation project. I am referring to the Junior Foresters course which is being taught there at the present time. Although this is at the elementary level it is possible that some such course could be worked out at the high school level. Another example is the work of Roberts Mann, Supt. of Conservation, Forest Preserve District, Cook County. He has sponsored field trips, nature schools, written nature bulletins and given many talks to school groups.

We should teach the students to make better use of their local

forest preserves, state and national parks. If these conservation projects do not exist in our localities they should be created because here the student will see all ecological principles at work.

In conclusion I would like to reemphasize what I have said before, that much depends upon the individual teacher. In order to do the best job of teaching possible we should all be interested in our own self-improvement and in new and more effective methods of education. Education is a continuous process and we are no exceptions to this rule. We should be familiar with the locality where we teach and know the needs of that locality. We should avail ourselves of the many opportunities which most of us have to improve our minds and techniques of teaching.

NEW FILMSTRIPS

Eight new filmstrips on functions and characteristics of the human body have been released by Encyclopaedia Britannica Films, C. Scott Fletcher, EB Films president, announced. The series, THE HUMAN BODY—SERIES TWO, supplements an earlier issue and brings to 16 the number of filmstrips on the human body now available.

The eight new filmstrips are MECHANISMS OF BREATHING, CONTROL OF BODY TEMPERATURE, WORK OF THE KIDNEYS, POSTURE AND EXERCISE, NERVOUS SYSTEM, EARS AND HEARING, ENDOCRINE GLANDS, AND HEREDITY.

The new series, as in the first group, were taken from EBF motion pictures on human biology and are designed to be used as a supplement to the films or alone. Although the 16 filmstrips were directed principally at junior high school general science classes, their content is sufficiently advanced to be of interest to high school biology classes and classes in nursing. Some of the strips will be valuable also to specialized classes such as psychology.

The previous series included HEART AND CIRCULATION, DIGESTION OF FOODS, FOODS AND NUTRITION, EYES AND THEIR CARE, THE TEETH, CARE OF THE FEET, BODY DEFENSES AGAINST DISEASE, and REPRODUCTION AMONG MAMMALS.

The new series costs $21.60 and may be obtained from any of the seven Encyclopaedia Britannica Films regional offices located in New York, Boston, Detroit, Chicago, Atlanta, Dallas, and Pasadena, or from Wilmette, Illinois.

A MESSAGE FROM PRESIDENT MEYER

On page 594 of this issue will be found a message from our Association President, Mr. Allen F. Meyer. Dr. Paul Trump, the President elected for the present year, was forced to resign to protect his health. Mr. Meyer, the Vice-President, took over the work just before the spring business meeting. This is his first message to you. Watch for the Convention program in our next issue.

THE SOUTH LOOKS TO ITS RESOURCES

RICHARD L. WEAVER

Director of Resource-Use Education, North Carolina Department of Public Instruction, Chapel Hill, N. C.

Schools in the South are much like the schools in other parts of the United States—surrounded with a world of opportunity to help plan for the future. Some feel a responsibility for helping to build strong communities and to use resources wisely, others sit idly by, using texts as the only tools of instruction and literally let the hills wash away around them, the streams fill up with agricultural, industrial and community wastes and the forests burn down through carelessness.

Fortunately a larger number of our teachers and administrators are aware of our opportunities now, through an intensive region-wide effort to discuss the resource problems, to work out plans for teaching about them and to engage in real-life solutions to some of them.

The Committee on Southern Regional Studies in Education of the American Council on Education spear-headed this drive. Work conferences and workshops were held where educators and resource technicians worked out effective patterns of actions. These were not paper reading sessions but work sessions where definite plans were crystallized.

Out of these regional meetings grew state, college and local workshops and conferences. State Committees and Commissions were organized to execute the plans.

Several writing projects were undertaken to develop materials needed so badly. A handbook on Resource-Use Education has been written cooperatively by a group which met regularly at the Daytona work conference in Florida. It has now been published. A companion volume is now in preparation which will serve as a guide for Resource-Use Education workshops.

A text called *Exploring the South* was prepared for regional use and published by the University of North Carolina Press, after being reviewed and experimentally tested by hundreds of teachers.

State volumes have been prepared: *Florida Wealth or Waste* and *North Carolina Today* for classroom use. A great many supplementary materials have been prepared in Alabama, Mississippi, Texas, Arkansas, Tennessee, Virginia, Florida and North Carolina.

Resource films have been prepared in Florida, Georgia, and North Carolina by the Southern Educational Film Production Service at Athens, Georgia. This service was developed at the instigation of the Committee on Southern Regional Studies in Education, when it was

found that there was enough interest and need to support a nonprofit making service in the audio-visual field.

In North Carolina, a series of radio programs was also developed on the resources of the State, the management problems and recommendations. Seven state agencies cooperatively sponsored these radio programs and a film called *Tar Heel Family* is now in production. These seven agencies are a part of a commission of forty-six appointed by the Governor in 1945 to stimulate Resource-Use Education in the State.

There has been as much emphasis on the training of leaders as on the production of materials. Hundreds of summer workshops have been held in every state in the South. Resource consultants have been used widely from all state, federal and private agencies concerned with resource management. Extensive use of field trips, demonstrations, group discussions and planning, audio-visual materials and individual and group productions of back-home plans, have been special features in most of these workshops.

Cities and counties have likewise held in-service workshops where local problems were analyzed and special plans made for their solution and attention in the schools and communities.

As in all state or region-wide efforts to introduce new ideas, concepts and emphasis in any school program, the test is in the classroom and community. How much has the child learned, what improvements have been made in the type of material taught, what changes are discernible in the community? Can we see any better resource management practices? Are we conserving, restoring and developing our resources to the fullest? Few tests or means of evaluation have been devised to show this.

However, we can see such things as thousands of trees planted, cover strips for wildlife, school grounds improved, bird houses and feeding stations erected, school forests established, units of study developed on cotton, tobacco, forests, soil conservation, minerals, health, wildlife, and many others. Exhibits at county and state meetings indicate much good work in all these fields.

Summaries of some of these projects and programs are available from the various states. Some of the sources of materials and information are indicated for those who want to explore any of them in detail.

Resource-Use Education is a blending of the fields of social and physical sciences to make better use of all of our technical information through greater interchange among groups and individuals, to supply more rewards to all the people. These dividends should be expressed by means of better health, more employment and money through new and better industry and agriculture, more recreational

time and facilities, better schools and school programs, better roads and communication facilities.

These institutional resources grow out of better use of our natural and human resources. Such important by-products as better relations among groups and peoples result from a unified approach to problem-solving and through improvement in all three of our major resource fields—natural, human and social.

The South has made a significant contribution to the field of education by means of this regional approach, the functional closely-integrated inter-state cooperation and the production of so much literature on the real problems and potentialities of the region.

SOURCES OF INFORMATION AND MATERIALS

Alabama

1. *Will Saunders*, Alabama Department of Education, Montgomery
2. *Paul Irvine*, Alabama Polytechnic Institute, Auburn

3 and 4. *Ernest Neal* and *Deborah Partridge*, Tuskegee Institute, Tuskegee

Florida

5. *Henry Becker*, Florida State University, Tallahassee
6. *Charles Durrance*, University of Florida, Gainesville

South Carolina

7. *T. F. Dowling*, S. C. Department of Education, Columbia
8. *A. C. Flora*, Superintendent of Schools, Columbia

Georgia

9. *Maenelle Dempsey*, Georgia Department of Education, Atlanta
10. *Rheba Burnam*, University of Georgia, Athens

Mississippi

11. *H. J. Jacobs*, Delta State Teachers College, Cleveland
12. *Lee B. Gaither*, Mississippi State College, State College

Tennessee

13. *Theron H. Hodges*, Tennessee Department of Education, Nashville
14. *Lillian Worley*, University of Tennessee, Knoxville

Kentucky

15. *Elizabeth A. Taylor*, Kentucky Department of Education, Lexington

16 and 17. *Edgar Carter* and *Collus Johnson*, Murray State Teachers College, Murray

Texas

18. *J. B. Rutland*, Texas Department of Education, Austin
19. *E. B. Evans*, Prairie View A. and M., Prairie View

Arkansas

20. *Roy W. Roberts*, University of Arkansas, Fayetteville

North Carolina

21, 22 and 23. *Richard L. Weaver*, *Samuel E. Duncan* and *Homer A. Lassiter*, North Carolina Department of Public Instruction, Raleigh

Virginia

24. *Al Wingo*, Virginia Department of Education, Richmond

Regional

25. *John E. Ivey, Jr.*, 316 Peachtree Street, Atlanta, Georgia
26. *William McGlothlin*, 316 Peachtree St., Atlanta, Georgia
27. *Charles Spain*, George Peabody College for Teachers, Nashville, Tennessee
28. *Mildred Teasley*, TVA, Educational Relations, Knoxville
29. *Herman Daves*, TVA, Educational Relations, Knoxville
30. *Clifford Seeber*, TVA, Educational Relations, Knoxville
31. *William Clifford*, Southern Educational Film Production Service, Athens, Georgia
32. *George Stoney*, Southern Educational Film Production Service, Athens, Georgia

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SPECIAL SYMBOLS FROM STANDARD TYPE

RONALD L. IVES
Indiana University, Bloomington, Indiana

Increasing use of Greek letters, and of other symbols not included in standard type fonts, coupled with a continuing shortage of type, and ever-increasing printing costs, has delayed the publication of many technical papers, and has made the printing of others almost prohibitively costly.

A part of this symbol difficulty has been offset by the practice of writing the equations longhand, using, in some instances, a lettering guide or other aid; and then reproducing the equation or notation as a line cut. This procedure is satisfactory only when the author is a skilled draftsman, or when the standards of illustration of the publication concerned are low.

Very satisfactory lettering, using standard type faces, is possible when transparent, self-adhesive letters are used. Special symbols, however, are not included in standard type sheets as now supplied and special printing of nonstandard symbols is very costly.

Rather fortunately, there are only a relatively few line forms in any alphabet, and most of these line forms are included in most alphabets, although not always in the same order and arrangement. Hence, most of the components of any alphabet are included in at least several others. By a fairly simple rearrangement of components, workmanlike special symbols can be made from standard "trans-adhesive" type, and this special symbolism matches the standard lettering, so that no disconcerting appearances of "wrong font" are found in the final copy.

As an example of what can be done by rearranging letter components, Figure 1 shows a complete Greek alphabet, made up from standard English type. Here, in parallel columns, are shown the

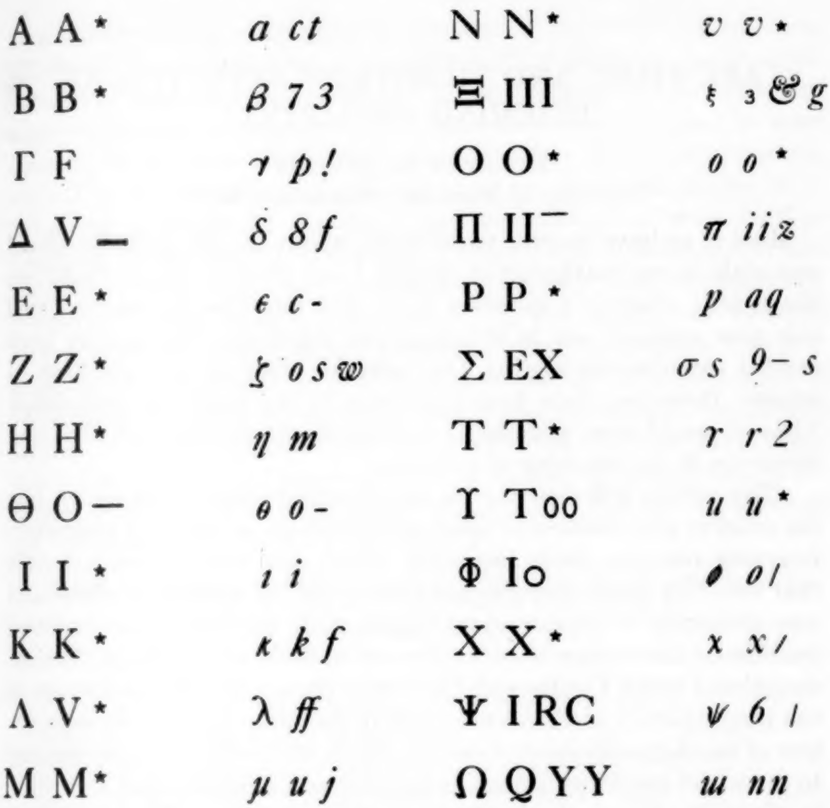

FIG. 1. Greek alphabet produced by rearranging components of standard English type.

Greek letters, both caps and l.c., and adjacent to each are shown the English letters from which the Greek letter was composed. Greek letters followed by an identical component letter and marked with a * are identical with the English letters as supplied. Type here used as originals for most of the Greek letters was Caslon 48 pt. for the caps (Artype 1011) and Caslon 48 pt. italic for the l.c. (Artype 1070).

Similar modifications of other standard type faces can be made to produce not only Greek letters, but many mathematical symbols, and letters from other "difficult" alphabets, such as Russian. It should be noted that the "gingerbread" ampersand, supplied on most type sheets, will supply many of the odd shapes not found in standard letters.

Fish bowl for display purposes has a tubular glass handle stretching over the top from side to side through which small fishes can swim. Atmospheric pressure keeps the water in the handle after it is once filled.

ARE FILMS AND FILMSTRIPS EFFECTIVE IN TEACHING GEOMETRY?

DONOVAN A. JOHNSON
University of Minnesota, Minneapolis, Minn.

Most of us have become enthusiastic about the use of audio-visual materials in our mathematics classes. Even though we are "sold" on visual aids, there is a question as to how effective the audio-visual aids now available are in attaining our objectives. There have been several experiments testing the value of films in the teaching of science. However, there have been none in the field of mathematics. Thus, it would seem worthwhile to investigate the value of films and filmstrips in the teaching of geometry.

This article will describe an experimental study designed to test the relative effectiveness of films and filmstrips in teaching geometry. Learning resulting from projected visual aids was contrasted with that resulting from conventional instruction by using four films[1] and four filmstrips[2] in experimental classes while control classes received traditional instruction without the use of films or filmstrips. The instructional units, Circles and Loci, were chosen to take advantage of the potentialities of visual aids and at the same time be representative of mathematics subject matter. With the circle so closely related to the wheel and locus defined as the path of a point moving according to given conditions, both of these units contain material in which motion is a factor.

In order to satisfy the standards of modern experimental design and statistical analysis, the requirements of randomization, replication and local control were carefully met. Random numbers were used to select the schools and classes; replication was provided by conducting 15 independent experiments in 27 classes; local control was satisfied since each of the 15 experiments had its own experimental and control groups. Variables such as content, teaching method, time and learning activities were controlled by requiring them to be the same in the experimental and control classes. However, each participating instructor was free to use any method, materials, assignments, activities, amount of time, or tests she desired for the experimental units provided she used them equally in the control and experimental classes.

The learning of the participating students was measured by objec-

[1] *Circles, Angles and Arcs of Circles, Chords and Tangents of Circles,* and *Locus.* Knowledge Builders, 625 Madison Ave., New York City.

[2] *Postulates-Triangles and Circles, Vocabulary-Circle I, Vocabulary-Circle II,* and *Locus.* Curriculum Films Inc., RKO Building, New York City.

tive tests which were designed to measure (1) informational learning, (2) development of fundamental skills and (3) ability to make applications of geometric principles and facts. These tests were also used as pre-tests and as retention-tests. Retention was measured in some classes two months after completing the study of the experimental unit. The scores of the participating students on mental ability tests, pre-tests, achievement post-tests, and retention tests were used as the basis for the statistical analysis. The significance of the differences between means of the experimental and control classes was tested by Fisher's "t" test or wherever possible, by the analysis of variance and covariance. The analysis of variance and covariance makes it possible to partial out the effects of an initial lack of equivalence of the classes. It makes it possible to conduct an experiment with intact classes without matched pairs being involved. In this experiment mental test scores and pre-test scores were used to hold constant the effects of mental ability and initial information. The results obtained are summarized in Tables I through IV.

TABLE I. SUMMARY OF THE DIFFERENCES BETWEEN EXPERIMENTAL AND CONTROL CLASSES ON ACHIEVEMENT POST-TESTS ON THE CIRCLE UNIT

	Experimental Treatment								
3 Films 3 Film-strips	Film and Filmstrip			Films			Filmstrips		
Type of Learning	No Significant Difference	Experimental Groups Superior	Control Groups Superior	No Significant Difference	Experimental Groups Superior	Control Groups Superior	No Significant Difference	Experimental Groups Superior	Control Groups Superior
Informational	3	0	0	6	1	0	5	0	0
Problem Solving	3	0	0	7	0	0	5	0	0
Applicational	2	1	0	5	2	0	4	0	1
Total	8	1	0	18	3	0	14	0	1

TABLE II. SUMMARY OF THE DIFFERENCES BETWEEN EXPERIMENTAL AND CONTROL CLASSES ON ACHIEVEMENT POST-TESTS ON THE LOCUS UNIT

	Experimental Treatment								
1 Film 1 Film-strip	Film and Filmstrip			Films			Filmstrips		
Type of Learning	No Significant Difference	Experimental Groups Superior	Control Groups Superior	No Significant Difference	Experimental Groups Superior	Control Groups Superior	No Significant Difference	Experimental Groups Superior	Control Groups Superior
Informational	3	0	0	7	0	0	5	0	0
Problem Solving	2	1	0	6	0	1	5	0	0
Applicational	3	0	0	6	0	1	5	0	0
Total	8	1	0	19	0	2	15	0	0

It will be noted in Table I and II that very few differences between the means in immediate achievement of experimental and control groups were statistically significant. There were five differences in favor of experimental groups and three differences in favor of control groups out of a total of 90 differences computed. This shows how readily an incorrect conclusion might be drawn if a single experiment had been conducted in one school.

From Tables III and IV it is apparent that retention is definitely improved by the use of three films combined with three filmstrips. These results are remarkable when it is noted that these experimental groups were not statistically superior on achievement as measured at the end of the unit. The Locus unit, using one film and one filmstrip gives inconclusive results in retention as well as in immediate learning.

TABLE III. SUMMARY OF THE DIFFERENCES BETWEEN EXPERIMENTAL AND CONTROL CLASSES ON RETENTION-TESTS ON THE CIRCLE UNIT

	Experimental Treatment								
3 Films 3 Filmstrips	Film and Filmstrip			Films			Filmstrips		
Type of Learning	No Significant Difference	Experimental Groups Superior	Control Groups Superior	No Significant Difference	Experimental Groups Superior	Control Groups Superior	No Significant Difference	Experimental Groups Superior	Control Groups Superior
Informational	0	2	0	3	0	0	1	1	0
Problem Solving	0	2	0	3	0	0	2	0	0
Applicational	0	2	0	3	0	0	1	0	1
Total	0	6	0	9	0	0	4	1	1

TABLE IV. SUMMARY OF THE DIFFERENCES BETWEEN EXPERIMENTAL AND CONTROL CLASSES ON RETENTION-TESTS ON THE LOCUS UNIT

	Experimental Treatment								
1 Film 1 Filmstrip	Film and Filmstrip			Films			Filmstrips		
Type of Learning	No Significant Difference	Experimental Groups Superior	Control Groups Superior	No Significant Difference	Experimental Groups Superior	Control Groups Superior	No Significant Difference	Experimental Groups Superior	Control Groups Superior
Informational	2	0	0	2	0	1	2	0	0
Problem Solving	2	0	0	3	0	0	2	0	0
Applicational	2	0	0	2	0	1	2	0	0
Total	6	0	0	7	0	2	6	0	0

On the basis of these data, the following conclusions are stated:

1. The greatest contribution of the films and filmstrips now available for geometry classes seems to be in the area of applicational learning and retention. It is worthy of emphasis that these are probably the most important products of instruction.

2. In order to obtain significant results from the use of films and filmstrips in geometry instruction, it appears necessary to use several films combined with filmstrips as a supplement to regular instruction.

3. Present geometry films and filmstrips do not increase significantly the learning of geometric facts or problem solving skills.

4. The results show the need for replication if generalizations are to be drawn from experimental results.

In view of these results, it appears that audio-visual aids which are developed for use in mathematics classes might be more effective as aids to learning if they were designed to supplement rather than repeat the type of instruction which the students have in the typical mathematics classroom. The audio-visual aids used in this study contained material which was frequently similar to material presented in mathematics textbooks. Some of the material presented by the films used animated drawings that were similar to the type of illustrations which mathematics teachers customarily draw on the blackboard. Experimental results might be considerably more favorable to the effectiveness of visual materials if the audio-visual aids would bring to the classroom unique experiences that are vital and functional to the adolescent student, experiences, different from those supplied by textbook or teacher or by other non-visual aids.

Another implication from this study would indicate that if we are to secure audio-visual aids that actually enhance learning, careful experimental studies should be made testing the claims made for them before they are made available for instructional purposes. The number of experiments described in this study which resulted in significant differences in means were relatively few. And even when statistically significant results were obtained, one might raise the question as to whether the results are pedagogically significant to the point that the expense and effort attendant in the use of audio-visual material is justified. Additional experimentation is also needed to test the effectiveness of other types of materials of instruction such as charts, opaque projections, and stereographs.

On the basis of the cooperation obtained from the administrators and teachers of participating schools, it appears that experimentation in randomly selected schools is entirely feasible. The teachers who participated exhibited considerable interest in the experiment and cooperated in following directions and suggestions in a highly satisfactory manner. However, most of the participating teachers lacked training and experience in methods of research and in methods of

using visual materials. Furthermore, the time available to teachers in view of the usually heavy teaching load limits the extent to which they can prepare adequate lessons using available materials. There is also a need for the coordination of means of informing teachers of the materials that are available. Many of the teachers participating in this study had never used or seen a mathematics film or filmstrip before participating in this study.

A fourth implication from this study would indicate that other aspects of pupil development should be evaluated in terms of the effectiveness of visual materials. The effectiveness of various materials of instruction in the development of appreciations, attitudes, and insights is of considerable importance. In mathematics, other objectives such as the development of habits of accurate reasoning and ability to make elementary analysis are of such scope and ramifications as to warrant individual studies of modern tools of instruction. The results of the present study suggest that in any evaluation of teaching materials, more careful attention might be devoted to the reactions of the classroom pupil to situations in addition to achievement tests.

In any case it should be remembered that this experiment used films available in 1948. Newer and better films and filmstrips that are now becoming available may give results that are more favorable to visual aids in mathematics.

SOVIETS YEAR AGO CUT OFF MANGANESE, STEEL ESSENTIAL

Not enough tanks, not enough guns, not enough armor for aircraft carriers. This is the down-to-earth nightmare which a single item on the suddenly critical "strategic materials" list—the lumpy ore of a metal called manganese—has brought to the men planning national defense speed-up.

Few people outside the government and the steel industry know of a Russian embargo which cut off the U. S. from its major source of manganese more than a year ago—and the desperate efforts which have been taken since then to fill the gap.

Special railroad ore cars were sent to South Africa, transportation experts went to India last year, in the attempt to make up the 350,000-ton annual U. S. import of manganese ore from Russia which was suddenly cut to a mere trickle early in 1949.

The gap was closed, but this country is still vulnerable, for only about 10% of the manganese needs of the U. S. steel industry can be met by U. S. mines. The rest must be imported over long sea lanes.

There is no substitute for manganese in making steel, particularly the tough alloys needed for modern weapons of war. More manganese goes into steel than any other metal other than iron itself. If the supply were suddenly cut off, American steel furnaces would cool and close down.

AN ELEMENTARY DEVICE FOR SHOWING PROJECTILE MOTION

Julius Sumner Miller
Dillard University, New Orleans, La.

The following apparatus is easily built and lends itself to an interesting array of simple experiments on projectiles; "bombing from level flight," "dive-bombing," range, and angle of elevation.

The "bomber" is an inclined track made from a right-triangular wood block, of legs roughly 3″ and 2″ (that is, base 3″, altitude 2″), and slope, therefore, roughly 33° to 35°. The hypotenuse is slightly grooved to provide a smooth track down which a steel sphere (ball-bearing) is rolled. The sphere may be of $\frac{1}{2}''$ or even 1″ diameter. This sphere is the "bomb." A slight horizontal platform is provided at the top of the track on which the sphere may rest and from which it is dislodged *gently* to roll down the track.

We now determine the "muzzle velocity" of the bomb as it leaves the bomber, by two methods: (a) Equate the potential energy of the sphere at the top of the track to its kinetic energy at the bottom; this gives us $v=\sqrt{2gh}$; (b) Place the bomber (track) at one end of the table and from its base measure 2 meters along the table top. *Gently* dislodge the sphere from its pocket atop the incline and clock its time with a stopwatch for several runs over the 2 meter horizontal course. Neglecting the frictional losses, which may indeed be quite negligible for a steel sphere on a hard table top, the velocity along the path may be taken as uniform and computed directly.

Now place a drawing board on the table with its farther edge elevated some 10° or 15° above the front edge. Tack a large sheet of soft-finish drawing paper to the board and cover this with 4 carbon pages upside down, that is, carbon side against the drawing paper. Place the bomber (track) at the lower edge (on a small block the thickness of the drawing board) and shoot *directly up* the board. See Fig. 1. From the height h to which the ball rises on the drawing board, measurable by the carbon trace, the acceleration a on the board may be computed. (We know v, the muzzle velocity, and $v^2=2\,ah$.) Several trials give a fairly reliable figure for a on the inclined plane. *We are now ready to go to actual bombing.*

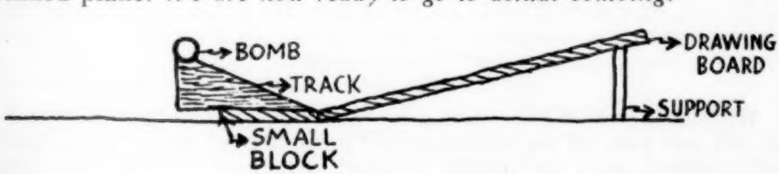

Fig. 1

I. (a) If the track (bomber) is parallel to the lower edge of the inclined board, it represents a bomber in *level flight*. See Fig. 2. Select some altitude for this bomber (say three-quarters up the left-hand edge of the board), measured from the bottom of the board. From $s=\frac{1}{2}at^2$ (we know a on the board and s is the measured altitude) *calculate* the time t for the bomb to reach the ground (the bottom of the board). Use this t to calculate the ***range*** of the bomb. (Range $R=vt$.) Now determine the range experimentally. The calculated and experimental results are amazingly close.

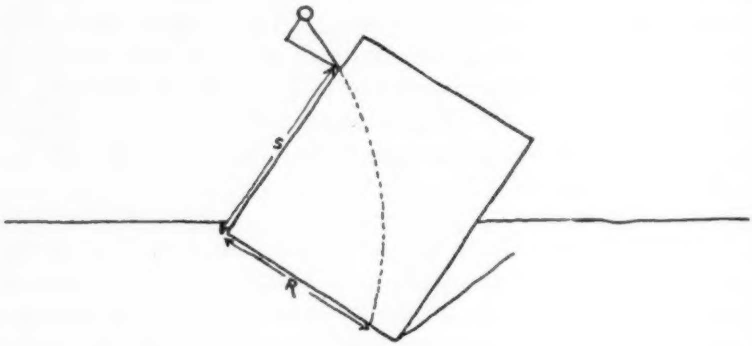

FIG. 2

I. (b) If the track is tilted *down* from the horizontal by 20° or 30° we obtain a trace of the bomb released from a ***dive bomber***. The computations here are a little more complicated, since vertical and horizontal components are involved, but if carried through give remarkably good results.

II. (a) Now place the track at the base of the drawing board (its "muzzle" end level with the board) and "shoot" the gun at 30°, 45°, and 60° elevation. These angles may be easily established with a protractor. As before, the calculated and experimental ranges and altitudes may be compared for each "firing." The condition for maximum range is beautifully demonstrated. The range may be shown to be given by $R=v^2 \sin 2\theta/g$ and the maximum elevation by $Y=v^2 \sin^2 \theta/2g$.

The writer will be glad to answer any questions.

Windshield protector, for use at drive-in movies, is a visor-like attachment to keep rain and snow off the windshield and promote good vision. It is a flexible plastic material, easily and quickly attached, that is held in place by a framework extending under the car's door.

SUGGESTED REVISIONS OF THE BY-LAWS

Central Association of Science and Mathematics Teachers

III. Officers

Section I. Officers: The officers of this association shall be a President, a Vice-President, a Secretary, a Treasurer and Business Manager, an Editor of the Journal, and an Historian. One or more Assistant Secretaries and Assistant Treasurers may be appointed by the President.

Section II. Qualifications: The President shall be nominated from the Board of Directors. The Vice-President shall have served at some time on the Board of Directors for at least one year.

Section III. Election, Tenure of Office, Compensation: The President and Vice-President shall be elected by the members of the association at the annual meeting and shall serve for a term of one year or until their successors are elected. The Treasurer and Business Manager, Editor of the Journal, Historian, and Secretary shall be appointed by the Board of Directors at a meeting to be held following the annual meeting of the association, and shall serve for a term of three years. Their terms may be renewable. The compensation of the officers, if any, shall be fixed by the Board of Directors.

Section IV. Powers and Duties of Officers: (a) President: The President shall preside at all general meetings of the association and shall perform the usual duties of his office. He shall be chairman of the Board of Directors and chairman of the Executive Committee, and shall perform the usual duties of those offices.

(b) Vice-President: He shall act for the President in the latter's absence. He shall also serve as a member of the Executive Committee.

(c) Secretary: The Secretary shall keep all records, minutes of all meetings and shall prepare and submit a complete report of the annual meeting to the Editor of the Journal by December 31 following the meeting.

(d) Treasurer and Business Manager: The Treasurer and Business Manager shall collect all dues and hold all moneys and keep a record of all receipts and disbursements. He shall give a report at the annual meeting of the association. He shall pay out funds on the order of the Board of Directors and the Executive Committee. He shall also act as Business Manager of the Journal.

(e) Editor of the Journal: The Editor of the Journal shall be responsible for the Journal, in all phases except business management.

(f) Historian: The Historian shall be charged with the responsibility of collecting and preserving the historical documents of the association.

IV. Board of Directors

Section II. Number: There shall be fifteen (15) members of the Board of Directors. The President, the Vice-President, and the President of the preceding year shall be members of the board of directors. The remaining members of the Board of Directors shall be divided into three groups of four (4) directors each. Four directors shall be elected annually to succeed those of the group whose terms are about to expire.

Section IV. Election, Tenure of Office and Compensation: Directors shall be elected by a majority vote of the members present at any annual meeting. They shall assume the duties of their office immediately preceding the adjournment of the annual meeting and shall serve for a period of three years or until their successors are elected. They shall serve without compensation, except that they may be allowed a reasonable compensation for traveling, and necessary expenses incurred by them in the discharge of their official duties.

Vacancies in the Board of Directors or list of officers shall be filled by the Board of Directors at any meeting thereof. A director so chosen shall serve until the next annual business meeting when a successor shall be elected to fill the unexpired term.

Whenever directors are elected, whether at the expiration of a term or to fill vacancies, a certificate under the seal of the association giving the names of those elected and the term of their office shall be recorded by the Treasurer and Business Manager in the office of the recorder of deeds where the certificate of organization is recorded.

SECTION VIII. POWERS AND DUTIES: The Board of Directors shall (1) have general supervision of the activities of the association; (2) authorize the expenditure of funds; (3) fix the salary and bonds of the officers; (4) fill vacancies.

V. EXECUTIVE COMMITTEE AND OTHER COMMITTEES

SECTION I. EXECUTIVE COMMITTEE: (a) MEMBERS: Members of the Executive Committee shall consist of the President, Vice-President, and immediate past president and shall serve for one year or until their successors have been elected.

SECTION IV. PROFESSIONAL SECTIONS AND GROUPS: The association may be organized into sections and groups. The organization and activities of the sections or groups shall be determined from time to time by the Board of Directors. Unless otherwise provided by the Board of Directors each section or group shall elect its own Chairman, vice Chairman and Secretary.

SECTION VII. THE POLICY AND RESOLUTIONS COMMITTEE: The Policy and Resolutions Committee shall consist of six (6) members. Each member shall serve three years. Two members shall be chosen annually by the President to replace the two whose terms are about to expire. One of those chosen annually must be from the Board of Directors. The President will annually designate the chairman of this committee. The chairman so selected shall have been a member of the committee for at least one year.

PROBLEM DEPARTMENT

CONDUCTED BY G. H. JAMISON

State Teachers College, Kirksville, Mo.

This department aims to provide problems of varying degrees of difficulty which will interest anyone engaged in the study of mathematics.

All readers are invited to propose problems and to solve problems here proposed. Drawings to illustrate the problems should be well done in India ink. Problems and solutions will be credited to their authors. Each solution or proposed problem sent to the Editor should have the author's name introducing the problem or solution *as on the following pages.*

The editor of the department desires to serve his readers by making it interesting and helpful to them. Address suggestions and problems to G. H. Jamison, State Teachers College, Kirksville, Missouri.

SOLUTIONS AND PROBLEMS

Note. Persons sending in solutions and submitting problems for solutions should observe the following instructions.

1. Drawings in India ink should be on a separate page from the solution.

2. Give the solution to the problem which you propose if you have one and also the source and any known references to it.

3. In general when several solutions are correct, the one submitted in the best form will be used.

Late Solutions

2167-8-9, 2173-6-9, 2180-1-2-3-5-8-9. *Prasert Na Nagara, Thailand.*

2185-2189. *E. C. Rodway, Schumacher, Canada.*

2189. *Anthony Bielecki, Jr.; Chicago.*

2189. *Edward Bieszczad, Chicago.*

2182–3. *John Jones, Jr.; Mississippi Southern College.*

2185, 8, 9. *J. W. W. A. Wit, Utrecht University, Holland.*

2191. *Proposed by Adrian Struyk, Paterson, N. J.*

Find expressions as simple as possible for the relation between x and y, and the relation between $(x+y)$ and $(x-y)$, given that

$$a+b\cos 2x+b\sin 2x\tan(x+y)=0.$$

Solution by the proposer

Divide the given equation by b, and substitute for the tangent function.

$$\frac{a}{b}+\cos 2x+\frac{\sin 2x\sin(x+y)}{\cos(x+y)}=0.$$

$$\frac{a}{b}+\frac{\cos 2x\cos(x+y)+\sin 2x\sin(x+y)}{\cos(x+y)}=0.$$

$$\frac{a}{b}+\frac{\cos(x-y)}{\cos(x+y)}=0. \tag{1}$$

$$\frac{a}{b}+\frac{\cos x\cos y+\sin x\sin y}{\cos x\cos y-\sin x\sin y}=0.$$

$$\frac{a}{b}=\frac{\tan x\tan y+1}{\tan x\tan y-1}.$$

$$\tan x\tan y=(a+b)/(a-b). \tag{2}$$

Other solutions were offered by the following: Hugo Brandt, Chicago, Ill.; C. W. Trigg, Los Angeles City College; Bernard Katz, Brooklyn College; E. C. Rodway, Schumacher, Canada; P. Na Nagara, Thailand; J. W. W. A. Wit, Utrecht University.

2192. *Proposed by Francis L. Miksa, Aurora, Ill.*

Find all sets of two numbers, x and y of five digits each, such that $y=5x$ and x and y contain all the ten digits.

Solution by C. W. Trigg, Los Angeles City College

If $y=Kx$ and x and y together contain all the ten digits, then $(x+y)=(1+K)x\equiv 0 \pmod 9$. If $K=5$, then $6x\equiv 0 \pmod 9$, so $x\equiv 0 \pmod 3$. Also, $02469=12345/5<x<98760/5=19752$. Thus the initial digit of x is 0 or 1, and the terminal digit of y is 5 or 0. Since $y=10x\div 2$, it is apparent that if x begins with 0, x is odd; if x begins with 1, x is even. With these properties in mind, we proceed to find the 24 required sets of numbers without a great deal of labor.

x	y	x	y	x	y	x	y
02937	14685	14586	72930	02967	14835	13458	67290
09237	46185	14658	73290	02697	13485	13584	67920
02973	14865	15846	79230	09627	48135	13854	69270
09723	48615	15864	79320	02769	13845	15384	76920
03297	16485	18546	92730	06297	31485	14538	72690
03729	18645	18654	93270	07629	38145	18534	92670

It will be observed that the values of x group themselves into permutations of 4 sets of digits, occurring six times each. Note that these sets are mutually exclusive in pairs.

Values of x for $K=2, 3, 4, 5$ are given in ***American Mathematical Monthly,***

Vol. 42, pp. 566–7, November 1935. There it is shown that 11 is the smallest value of K, not a power of 10, for which no solution exists. In the same magazine, Vol. 53, pp. 45–6, January 1946, values of x, without an initial zero digit, are given for $K=2, 3, 4, 5, 7, 8, 9$.

Other solutions were offered by P. Na Nagara, Thailand; A. MacNeish, Chicago; Hugo Brandt, Chicago; J. W. W. A. Wit, Utrecht University.

2193. *Proposed by Mrs. Edith Warne, Alton, Ill.*

Solve the system

$$x^3+1/y^3=2$$
$$1/x^3+y^3=2$$

Solution by Aaron Buchman, Buffalo, N. Y.

Multiplying the two given equations together and simplifying, yields the relation,

$$x^3=1/y^3. \tag{1}$$

Substituting relation (1) in the first of the given equations, gives $(x^3-1)^2=0$ and solving for x, yields the roots,

$$x=1,\quad \tfrac{1}{2}(-1+i\sqrt{3}),\quad \tfrac{1}{2}(-1-i\sqrt{3}) \qquad \text{(each double)} \quad (2)$$

The values given in (2) are the three cube roots of unity. Therefore, replacing x^3 by 1 in the second of the given equations, and solving for y, yields the roots,

$$y=1,\quad \tfrac{1}{2}(-1+i\sqrt{3}),\quad \tfrac{1}{2}(-1-i\sqrt{3}). \tag{1}$$

Since *any* x in (2) may be paired with *any* y in (3), there are *nine* distinct sets of solutions to the given system of equations.

Other solutions were offered by the following: Keith Jones, Anderson, Ind.; Robert Hooper, Waterville, Maine; Burton West, Port Arthur, Texas; John Beemster, Chicago; Margaret Joseph, Milwaukee, Wis.; Max Beberman, Shanks Village, N. Y.; O. A. George, Mason City, Ia.; J. H. Means, Austin, Texas; Elbert Weaver, Andover, Mass.; A. MacNeish, Chicago; Hugo Brandt, Chicago; Irwin Tessman, Ithaca, N. Y.; D. McLeod, Winnipeg, Canada; Norman Anning, Ann Arbor, Michigan; V. C. Bailey, Evansville, Ind.; David Rappaport, Chicago; Ray Hanna, Wichita, Kan.; C. W. Trigg, Los Angeles City College; Bernard Katz, Brooklyn College; E. C. Rodway, Schumacher, Canada; P. Na Nagara, Thailand; J. W. W. A. Wit, Utrecht University.

2194. *Proposed by Alan Wayne, Flushing, N. Y.*

What are the two ways in which fifty coins are the correct change for a dollar?

Solution by W. J. Cherry, Berwyn, Ill.

A half-dollar cannot be one of the coins, for then we should need 49 other coins to give a total value of fifty cents—obviously an impossibility. Hence:

$$\begin{array}{r} p+5n+10d+25q=100 \\ p+\ \ n+\ \ \ d+\ \ \ q=\ \ 50 \\ \hline 4n+\ 9d+24q=\ \ 50 \end{array}$$

Evidently the number of quarters cannot exceed one. If the number of quarters is one, we have $4n+9d=26$, which has the solution $n=2$, $d=2$. If there are no quarters, we have $4n+9d=50$, which has the solution $n=8$, $d=2$.

Hence we may have 45 pennies, 2 nickels, 2 dimes and 1 quarter; or 40 pennies, 8 nickels, and 2 dimes.

Other solutions were offered by the following: Cecil B. Read, Wichita, Kan.; Joseph Haefner, Chicago; Aaron Buchman, Buffalo, N. Y.; Max Beberman, Shanks Village, N. Y.; Francis Miksa, Aurora, Ill.; James Means, Austin, Texas;

Bernard Katz, Brooklyn, N. Y.; D. McLeod, Winnipeg, Canada; C. W. Trigg, Los Angeles City College; V. C. Bailey, Evansville, Ind.; Keith Jones, Anderson, Ind.; Elbert Weaver, Andover, Mass.; O. A. George, Mason City, Ia.; Hugo Brandt, Chicago; P. Na Nagara, Thailand; E. C. Rodway, Schumacher, Canada.

2195. *Proposed by Adrian Struyk, Paterson, N. J.*

Each side of a triangle ABC is the diameter of a semicircle. Each semicircle contains an inscribed square which has two vertices on the arc and two on the diameter. The points on the sides of triangle ABC are named according to the orders BA_1A_2C, CB_1B_2A, AC_1C_2B. B_1B and C_1C intersect at A'; C_1C and A_1A at B'; A_1A and B_1B at C'. Prove that the four triangles $A'BC$, $AB'C$, ABC', $A'B'C'$ are equal in area.

Solution by the proposer

We may begin by evaluating the ratio of the two segments into which A_1, B_1, C_1 divide the respective sides. The figure shows the square $PQRS$ inscribed in a semicircle having diameter HK. Join R with the common midpoint M of HK and PQ. Consider the segments whose lengths are marked on the figure. Since $MK = MR$ we have $x+w=x\sqrt{5}$. Hence $w/x=\sqrt{5}-1$. Therefore

$$\frac{HQ}{QK}=\frac{w+2x}{w}=\frac{(w+2x)/x}{w/x}=\frac{(w/x)+2}{w/x}=\frac{\sqrt{5}+1}{\sqrt{5}-1}=\tfrac{1}{2}(3+\sqrt{5}). \tag{1}$$

It is evident from (1) that we have a particular case of

$$AB_1:B_1C=CA_1:A_1B=BC_1:C_1A=n, \tag{2}$$

where n is a constant. According to problems and articles previously appearing in this journal (see references below), under the condition (2) the triangles $A'BC$, $AB'C$, and ABC' are equal, and

$$\triangle ABC:\triangle A'B'C':\triangle A'BC=(n^2+n+1):(n-1)^2:n.$$

Hence

$$\triangle A'B'C'=\triangle A'BC=\triangle AB'C=\triangle ABC' \quad \text{if} \quad (n-1)^2=n.$$

Exactly this happens when $n=\frac{1}{2}(3+\sqrt{5})$.

References to previous issues of School Science and Mathematics:

Vol. 40, pp. 483–485, May 1940, problem 1650.
Vol. 43, pp. 684–685, Oct. 1943, problem 1821.
Vol. 41, pp. 765–767, Nov. 1941, "On a Problem of Steinhaus."
Vol. 42, pp. 325–330, Apr. 1942, "Additional Notes on a Steinhaus Problem."

In the first three of these references n denotes the side:segment ratio rather than the segment:segment ratio, so that the various results require reconciliation.

Other solutions were offered by C. W. Trigg, Los Angeles City College; Hugo Brandt, Chicago; W. J. Cherry, Berwyn, Ill.; Max Beberman, Shanks Village, N. Y.; P. Na Nagara, Thailand.

2196. *Proposed by V. C. Bailey, Evansville, Ind.*

Regular inscribed and circumscribed polygons of the same number of sides have their areas in the ratio 3:4. Find the number of sides.

Solution by W. J. Cherry, Berwyn, Ill.

Let the radius of the inscribed polygon be the apothem of the circumscribed polygon. Denote the radius of the inscribed polygon by r and the radius of the circumscribed polygon by R. Since the areas are proportional to the squares of the radii, we have

$$\frac{r}{R}=\frac{\sqrt{3}}{2}.$$

Thus the cosine of half a central angle for either polygon is $\sqrt{3}/2$, and hence a central angle measures 60°. The number of sides, therefore, is 6.

Other solutions were offered by the following: O. T. Shannon, Wheeling, W. Va.; C. W. Trigg, Los Angeles City College; O. A. George, Mason City, Ia.; Bernard Katz, Brooklyn, N. Y.; Max Beberman, Shanks Village, N. Y.; Aaron Buchman, Buffalo, N. Y.; Margaret Joseph, Milwaukee, Wis.; A. MacNeish, Chicago, Ill.; J. W. W. A. Wit, Utrecht University; E. C. Rodway, Schumacher, Canada.

HIGH SCHOOL HONOR ROLL

The editor will be very happy to make special mention of high school classes, clubs, or individual students who offer solutions to problems submitted in this department. Teachers are urged to report to the Editor such solutions.

2193. *Barry C. Dutcher, San Antonio, Texas.*

2192–4. *Rita Dadak, Jane M. Cummings, Eileen Bradshaw and Carol Boland, all from Convent Station, New Jersey.*

2194. *Gene Phillips and Richard Lehmann, Racine, Wis.; Jim Perrung, John Franke, Eddie Dewees, San Antonio, Texas; Walter A. Stahl, Cleveland, Ohio.*

2185. *Clyde Linder, Red Bank, N. J.*

PROBLEMS FOR SOLUTION

2209. *Proposed by William W. Johnson, Cleveland, Ohio.*

A horizontal cylindrical tank is 72 in. long, with a diameter of 15 inches. The ends are cones with altitude of 7.5 inches. Find the volume of the combined solid if the water in the cylinder is 8 inches deep.

2210. *Proposed by William W. Johnson, Cleveland, Ohio.*

Through the sphere $x^2+y^2+z^2=r^2$, planes $x=a$ and $z=b$ are passed. What is the volume cut from the sphere?

2211. *Proposed by C. W. Trigg, Los Angeles City College.*

If $\alpha_i, \beta_i, \gamma_i$ are the distances of the vertices A_i, B_i, C_i respectively to the points of contact of the incircle with the sides of the triangle $A_iB_iC_i$ having area Δ_i and if $\alpha_1+\beta_1+\gamma_1=\alpha_2+\beta_2+\gamma_2$ and $\alpha_1\beta_1\gamma_1=\alpha_2\beta_2\gamma_2$, then $\Delta_1=\Delta_2$. Give an example of two such triangles having integral sides.

2212. *Proposed by Gerald Sabin, University of Tampa.*

A 7 lb. body is attached to a fixed point by an elastic cord 10 feet long. It is released from rest at the support and it falls 14 feet before coming to rest. Find the time taken to make the fall.

2213. *Proposed by Alan Wayne, Flushing, N. Y.*

A one foot square is inscribed in a right triangle whose hypotenuse is 35. Find the other sides of the triangle if its right angle is an angle of the square.

2214. *Proposed by Alan Wayne, Flushing, N. Y.*

Determine the convex gradrilateral having the greatest area and least perimeter if its diagonals are fixed.

BOOKS AND PAMPHLETS RECEIVED

Television Simplified, Third Edition, by Milton S. Kiver, *Television Consultant, Radio and Television News Magazine.* Cloth. Pages vii+608. 13.5×20.5 cm. 1950. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York 3, N. Y. Price $5.20.

Mathematics in Daily Use, Revised Edition, by Walter W. Hart, *Author of Mathematics Texts;* Cottell Gregory, *Louisville Girls High School, Louisville, Kentucky,* and Veryl Schult, *Supervisor of Mathematics, Division I–IX, Washington, D. C.* Cloth. Pages vii+376. 13×20.5 cm. 1950. D. C. Heath and Company, 285 Columbus Avenue, Boston 16, Mass. Price $2.04.

The Foundations of Arithmetic, by Dr. G. Frege, *Professor at the University of Jena.* English Translation by J. L. Austin, M.A., *Fellow of Magdalen College, Oxford.* Cloth. Pages xxiv+238. 13.5×21.5 cm. 1950. The Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. Price $4.75.

General Chemistry, Second Edition, by John Arrend Timm, *Professor of Chemistry, Director of School of Science, Simmons College.* Cloth. Pages xii+764. 15×23 cm. 1950. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York 18, N. Y. Price $4.50.

An Introduction to Probability Theory and Its Applications, Volume One, by William Feller, *Professor of Mathematics, Cornell University.* Cloth. Pages xii+419. 14.5×23 cm. 1950. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $6.00.

The Anatomy of Mathematics, by R. B. Kershner, *Applied Physics Laboratory, The Johns Hopkins University,* and L. R. Wilcox, *Associate Professor of Mathematics, Illinois Institute of Technology.* Cloth. Pages xi+416. 15×23 cm. 1950. The Ronald Press Company, 15 E. 26th Street, New York 10, N. Y. Price $6.00.

General Biology for Colleges, Second Edition, by Gairdner B. Moment, Ph.D., *Professor of Biology, Goucher College.* Cloth. Pages xvi+680. 15×23.5 cm. 1950. Appleton-Century-Crofts, Inc., 35 W. 32nd Street, New York 1, N. Y. Price $5.00.

Basic Mathematics for General Education, by H. C. Trimble, F. C. Bolser, and T. L. Wade, Jr., *Mathematics Department, Florida State University.* Cloth. Pages xiii+313. 14×21 cm. 1950. Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y. Price $3.25.

Cross-Country, Geography for Children, by Paul R. Hanna and Clyde F. Kohn. Cloth. 160 pages. 19.5×27 cm. 1950. Scott, Foresman and Company, 433 East Erie Street, Chicago 11, Ill. Price $2.20.

Physics, A Textbook for Colleges, by Oscar M. Stewart. Fifth Edition, by Newell S. Gingrich, *Professor of Physics, University of Missouri.* Cloth. Pages vii+726. 15×23 cm. 1950. Ginn and Company, Statler Building, Boston 17, Mass. Price $5.00.

General Chemistry, Fourth Edition completely Revised and Rewritten, by H. I. Schlesinger, *The University of Chicago.* Cloth. Pages x+811. 13×21 cm. 1950. Longmans, Green and Company, Inc., 55 Fifth Avenue, New York, N. Y. Price $5.50.

Analytic Geometry and Calculus, by Harold J. Gay, *Late Professor of Mathematics, Worcester Polytechnic Institute.* Edited by Raymond K. Morley,

Professor of Mathematics, Worchester Polytechnic Institute. Cloth. Pages vii +524. 15×23 cm. 1950. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York 18, N. Y. Price $5.00.

MAN'S PHYSICAL UNIVERSE, A SURVEY OF PHYSICAL SCIENCE FOR COLLEGES, THIRD EDITION, by Arthur Talbot Bawden, *Stockton College, Stockton, California.* Cloth. Pages xv+822. 14×21.5 cm. 1950. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $4.75.

A COURSE IN GENERAL CHEMISTRY, SEMI-MICRO ALTERNATE FORM, THIRD EDITION, by William C. Bray, *Late Professor of Chemistry, University of California;* Wendell M. Latimer, *Professor of Chemistry, University of California;* and Richard E. Powell, *Associate Professor of Chemistry, University of California.* Cloth. Pages xiii+217. 13.5×21 cm. 1950. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $3.00.

THE AUTOBIOGRAPHY OF ROBERT A. MILLIKAN. Cloth. Pages xiv+311. 15×23 cm. 1950. Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y. Price $4.50

PRACTICAL MATHEMATICS. PART II, ALGEBRA WITH APPLICATIONS, FIFTH EDITION, by Claude Irwin Plamer, *Late Professor of Mathematics and Dean of Students, Armour Institute of Technology, Chicago, Illinois,* and Samuel Fletcher Bibb, *Associate Professor of Mathematics, Illinois Institute of Technology, and Armour College of Engineering.* Cloth. Pages xiii+252. 14×20.5 cm. 1950. McGraw-Hill Book Company, 330 W. 42nd Street, New York 18, N. Y. Price $2.20.

ELEMENTS OF ORDINARY DIFFERENTIAL EQUATIONS, by Michael Golomb, *Associate Professor of Mathematics, Purdue University,* and Merrill Shanks, *Associate Professor of Mathematics and Aeronautical Engineering, Purdue University.* Cloth. Pages ix +356. 15×23 cm. 1950. Price $3.50.

HEAT AND TEMPERATURE MEASUREMENT, by Robert L. Weber, *Associate Professor of Physics, The Pennsylvania State College.* Cloth. Pages x+422. 14 ×21.5 cm. 1950. Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y. Price $5.00.

ANALYTIC GEOMETRY, by Raymond D. Douglass, Ph.D., Sc.D., *Professor of Mathematics, Massachusetts Institute of Technology,* and Samuel D. Zeldin, Ph.D., *Associate Professor of Mathematics, Massachusetts Institute of Technology.* Cloth. Pages ix+216. 15×23 cm. 1950. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York 18, N. Y. Price $2.75.

PHYSICS: FUNDAMENTAL PRINCIPLES FOR STUDENTS OF SCIENCE AND ENGINEERING, by George Shortley, B.E.E., Ph.D., *Professor of Physics, The Ohio State University,* and Dudley Williams, A.D., Ph.D., *Associate Professor of Physics The Ohio State University.* Cloth. Volume I, pages xii+471+x. Volume II, pages xii+797. 15×23 cm. 1950. Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y. Price, Volume I, $4.50, Volume II, $5.50.

PLAY WITH TREES, by Millicent E. Selsam. Cloth. 64 pages. 15.5×20.5 cm. 1950. William Morrow and Company, Inc., 425 Fourth Avenue, New York 16, N. Y. Price $2.00.

INDIANS OF THE LONGHOUSE: THE STORY OF THE IROQUOIS, by Sonia Bleeker. Cloth. 160 pages. 12.5×18.5 cm. 1950. William Morrow and Company, Inc., 425 Fourth Avenue, New York 16, N. Y. Price $2.00.

OWLS, by Herbert S. Zim. Cloth. 61 pages. 16.5×20.5 cm. 1950. William Morrow and Company, Inc., 425 Fourth Avenue, New York 16, N. Y. Price $2.00.

RUBY THROAT: THE STORY OF A HUMMING BIRD, by Robert M. McClung, *As-*

sistant in the Department of Mammals and Birds at the New York Zoological Park. Cloth. 46 pages. 16.5×20.5 cm. 1950. William Morrow and Company, Inc., 425 Fourth Avenue, New York 16, N. Y. Price $2.00.

SONG OF THE SEASONS, by Addison Webb. Cloth. 127 pages. 16×21.5 cm. 1950. William Morrow and Company, Inc., 425 Fourth Avenue, New York 16, N. Y. Price $2.50.

TEXTBOOK OF INORGANIC CHEMISTRY, SIXTH EDITION, by J. R. Partington, M.B.E., D.Sc., *Professor of Chemistry in the University of London, Queen Mary College.* Cloth. Pages x+996. 13.5×21.5 cm. 1950. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $3.75.

POCKET ENCYCLOPEDIA OF ATOMIC ENERGY, Edited by Frank Gaynor. Cloth. 204 pages. 13.5×21.5 cm. 1950. Philosophical Library, 15 East 40th Street, New York 16, N. Y. Price $7.50.

PLANE TRIGONOMETRY, E. Richard Heineman, *Professor of Mathematics, Texas Technological College.* Alternate Edition. Cloth. Pages xiv+184+75. 14.5×23 cm. 1950. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York 18, N. Y. Price $2.50.

TEACHING BIOLOGY FOR APPRECIATION, by Alfred F. Nixon, B.S., S.M., Ed.D. Cloth. 146 pages. 13.5×20 cm. 1949. Chapman and Grimes, 30 Winchester Street, Boston, Mass. Price $3.00.

A GERMAN-ENGLISH DICTIONARY FOR CHEMISTS, THIRD EDITION, by Austin M. Patterson, *Professor Emeritus of Chemistry, Antioch College.* Cloth. Pages xviii +541. 12.5×17 cm. 1950. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $5.00.

GEOMETRY, MEANING AND MASTERY, by Samuel Welkowitz, Harry Sitomer, *New York City Schools;* Daniel W. Snader, *University of Illinois.* Cloth. Pages vi+506. 13.5×21.5 cm. 1950. The John Winston Company, 1010 Arch Street, Philadelphia 7, Pa. Price $2.60.

PROBLEM-SOLVING PROCESSES OF COLLEGE STUDENTS, by Benjamin S. Bloom, *College Examiner and Associate Professor of Education, University of Chicago,* and Lois J. Broder, *Research Assistant, University Examiner's Office, University of Chicago.* Cloth. 109 pages. 15×23.5 cm. 1950. The University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Ill. Price $2.75.

COMMERCIAL ALGEBRA, COLLEGE COURSE, THIRD EDITION, Revised and Enlarged, by Thomas Marshall Simpson, Ph.D., *Head of Mathematics Department and Dean of Graduate School, University of Florida;* Zareh M. Pirenian, M.S., *Associate Professor of Mathematics, University of Florida;* and Bolling H. Crenshaw, M.E., LL.D., *Late Head of Mathematics Department, Alabama Polytechnic Institute.* Cloth. Pages xi+173+19+ix. 15×23 cm. 1950. Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y. Price $2.50.

ELECTROMAGNETIC THEORY, by Oliver Heaviside. Complete and Unabridged Edition of Volume I, Volume II, and Volume III with a Critical and Historical Introduction by Ernst Weber, *Director, Microwave Research Institute, Polytechnic Institute of Brooklyn.* Cloth. Pages xxx+386. 22.5×31 cm. 1950. Dover publications, Inc., 1780 Broadway, New York 19, N. Y. Price $7.50.

WELTSYSTEM, WELTÄTHER UND DIE RELATIVITÄTSTHEORIE, EINE EINFÜHRUNG FÜR EXPERIMENTELLE NATURWISSENSCHAFTLER, Von Prof. Dr. Karl Jellinek, *vormals Direktor des Physikalisch-chemischen Instituts der Technischen Hochschule Danig.* Mit 40 Figuren und 4 Tabellen. Pages xv+450. 15×23 cm. 1949. Wepf und Company, Publishers, Basle, Switzerland. Price SFr. 45.

Verständliche Elemente der Wellenmechanik, Eine Einführung für experimentelle Naturwissenschaftler. I. Teil (Photonen, freie Elektronen, einelektronige Atome), Von Prof. Dr. Karl Jellinek, *vormals Direktor des Physikalisch-chemischen Institues der Technischen Hochschule Daniz.* Mit 82 Figuren und 1 Tabelle. Pages xii+304. 15×23 cm. 1950. Wepf and Company, Publishers, Basle, Switzerland. Price SFr. 34.

Mechanics via the Calculus, Third Edition, by P. W. Norris, M.A., B.Sc F.R.S.A., *Sometime Senior Mathematical Master, Alleyn's School, Dulwich,* and W. Seymour Legge, B.Sc., *Sometime Senior Lecturer in Mathematics, The Polytechnic, London, W. I.* Cloth. Pages xii+367. 13.5×21.5 cm. 1950. Dover Publications, Inc., 1780 Broadway, New York 19, N. Y. Price $3.95.

The Carus Mathematical Monographs, Number Nine. The Theory of Algebraic Numbers, by Harry Pollard, *Cornell University.* Cloth. Pages xii 143. 12.5×19 cm. 1950. Published by The Mathematical Association of America Buffalo 14, N. Y. Price $3.00.

The Carus Mathematical Monographs, Number Ten. The Arithmetic Theory of Quadratic Forms, by Burton W. Jones, *University of Colorado.* Cloth. Pages x+212. 12.5×19 cm. 1950. Published by the Mathematical Association of America, Buffalo 14, N. Y. Price $3.00.

Intermediate College Algebra, by Edward M. J. Pease, Ph.D., *Professor of Mathematics and Electrical Engineering, Mathematics Department Head, Rhode Island State College.* Cloth. Pages vii+420+36. 14×21.5 cm. 1950. Prentice-Hall Inc., 70 Fifth Avenue, New York 11, N. Y. Price $2.85.

The Philosophy of Mathematics, by Edward A. Mazairz, C.PP.S., M.S., Ph.D., *Saint Joseph's College, Collegeville, Indiana.* Cloth. Pages viii+286. 13.5×21.5 cm. 1950. The Philosophical Library, Inc., 15 East 40th Street, New York 11, N. Y. Price $4.00.

First Course in Probability and Statistics, Volume I, by J. Neyman, *The University of California, Berkeley.* Cloth. Pages x+350. 15×23 cm. 1950. Henry Holt and Company, 257 Fourth Avenue, New York 10, N. Y. Price $3.50.

The Size of It, A First Book about Sizes, by Ethel S. Berkley, Cardboard. 25 pages. 16×19 cm. 1950. William R. Scott, Inc., 8 West 13th Street, New York, N. Y. Price $1.00.

Experiences in Science, A Workbook to Accompany *Science for Better Living,* by Paul E. Blackwood, *Specialist for Elementary Science, U. S. Office of Education.* Paper. Pages iv+156. 19.5×27 cm. 1950. Harcourt, Brace and Company, New York 17, N. Y. Price $1.20.

Simplified Chemistry Experiments, by Armand Joseph Courchaine, *Instructor in Biological Chemistry, Hahnemann Medical College, Philadelphia, Pennsylvania.* Paper. Pages xxi+234. 19×27.5 cm. 1950. G. P. Putnam's Sons, 2 West 45th Street, New York, N. Y. Price $2.80.

A Systematic Laboratory Course in General Chemistry, by Harry H. Sisler and Jay J. Stewart, *Department of Chemistry, The Ohio State University, and formerly of The University of Kansas.* Paper. Pages xi+396. 19×28 cm. 1950 The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $3.00.

Exercises in General Chemistry, by Harold G. Dietrich, *Assistant Professor of Chemistry, Yale University;* and Erwin B. Kelsey, *Associate Professor of Chemistry, Yale University.* Paper. Pages x+285. 21×28 cm. 1950. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $3.00.

Television and E-M Receiver Servicing, Second Edition, by Milton S.

Kiver, *Television Consultant, Radio and Television News Magazine*. Paper. Pages iv+248. 21×28 cm. 1950. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York 3, N. Y. Price $3.25.

THE NEXT DEVELOPMENT IN MAN, by Lancelot Law Whyte. Paper. 255 pages. 10.5×18 cm. 1950. The New American Library of World Literature, Inc., 245 Fifth Avenue, New York 16, N. Y. Price 35 cents.

THE CAVE BOOK, by Charles E. Hendrix. Paper. 68 pages. 15.5×23 cm. 1950. The Earth Science Publishing Company, Revere, Mass. Price $1.00.

HOW TO BECOME A RADIO AMATEUR (11TH EDITION, 1950) published by the American Radio Relay League. Paper. 70 pages including 13-page advertising Section. 16×24 cm. American Radio Relay League, West Hartford 7, Conn. Price 50 cents.

PROJECTIVE SPHERICAL TRIGONOMETRY WITH SPECIAL APPLICATIONS TO CELESTIAL NAVIGATION, by Benjamin L. Kaufman, *Instructor in Mathematics and Science, James Monroe High School, New York City*. Paper. 38 pages. 16×21 cm. 1948. Benjamin L. Kaufman, 180 Riverside Drive, New York 24, N. Y.

THE EARLY DEVELOPMENT OF THE CONCEPTS OF TEMPERATURE AND HEAT. THE RISE AND DECLINE OF THE CALORIC THEORY, prepared by Duane, *Wabash College, Wabash, Indiana*. Paper. Pages iv+106. 15.5×22.5 cm. 1950. Harvard University Press, Cambridge 38, Mass. Price $1.25.

SPONSORING THE SCIENCE CLUB, by George Greosen Mallinson, *Professor of Education, Western Michigan College of Education, Kalamazoo, Michigan*. Faculty Contributions, Series II, No. I, April 1950. Paper. 18 pages. 15×23 cm. Western Michigan College of Education, Graduate Division, Kalamazoo, Mich. Price 10 cents.

MATHEMATICS AT WORK. HIGH LIGHTS OF THE 1949 INSTITUTE AT DUKE UNIVERSITY, W. W. Rankin, *Director and Professor of Mathematics, Duke University;* and William A. Gager, *Editor-in-chief, Professor of Mathematics, University of Florida, Gainesville, Florida*. Paper. 127 pages. 21.5×28 cm. Duke University, Durham, North Carolina.

THE EARTH FOR THE LAYMAN. SELECTED BOOKS AND PAMPHLETS (mostly nontechnical) ON GEOLOGY, MINING, ROCKS, MINERALS AND GEMS, FOSSILS, EVOLUTION AND RELATED SUBJECTS. Edited by Mark White Pangborn, Jr., *U. S. Geological Survey Library*. Issued by the American Geological Institute, an Agency of the National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D. C. Preliminary Edition. Report No. 2. Paper. June 1950. Price $1.00.

SCIENCE AND FOREIGN RELATIONS. INTERNATIONAL FLOW OF SCIENTIFIC AND TECHNOLOGICAL INFORMATION. Paper. Pages viii+170. 20×26 cm. Department of State, U.S.A.

WELCH DENSICHRON. 14 page pamphlet with illustrations and graphs for science, industry and the graphic arts. Available on request to W. M. Welch Scientific Company, 1515 Sedgwick Street, Chicago 10, Illinois.

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BOOK REVIEWS

ANALYSIS AND DESIGN OF EXPERIMENTS (*Analysis of Variance and Analysis of Variance Designs*) by H. B. Mann, *Professor of Mathematics, The Ohio State University.* Cloth. 13×19.5 cm. Pages x+198. 1949. Dover Publications Inc., 1780 Broadway, New York 19, N. Y. Price $2.95.

The title of a book does not always indicate the exact nature of the contents. The subject matter indicated by the title and sub-title is treated with primary emphasis upon the mathematical background rather than explanation of the procedures to be used in an experiment. To read the book with any degree of comprehension essentially the background of an undergraduate major in mathematics in required, for example, concepts of probability calculus and of matrix theory are encountered in the first few pages.

For the mathematician who wishes to understand the analysis of variance, or for the experimental statistician who has the necessary mathematical background, this book will prove of considerable value. It might be used as a text in advanced undergraduate or graduate courses, although some instructors will dislike the fact that there are no exercises or problems to illustrate the principles presented.

There is a large number of references to published literature on the subject, in several cases references are given to proofs considered beyond the scope of the book; likewise several places where complete knowledge of the situation involved is not yet available are pointed out.

The typography is good; two minor misprints were noted (p. 130, p. 133). The index is not always satisfactory; it is incomplete in some respects.

CECIL B. READ
University of Wichita

NUMERICAL SOLUTIONS OF DIFFERENTIAL EQUATIONS, by H. Levy, *Professor of Mathematics at the Imperial College of Science, University of London*, and E. A. Baggott, *Lecturer in Mathematics, The Polytechnic, Regent Street, London.* Cloth. 14×21 cm. Pages viii+238. 1950. Dover Publications, Inc., 1780 Broadway, New York 19, N. Y. Price $3.00.

This is the first American edition of a work previously published in England under the title "Numerical Studies in Differential Equations." Fundamentally, the text is concerned with various methods for obtaining approximate solutions of ordinary differential equations, including simultaneous equations. The first sixty pages are devoted to a discussion of graphical methods, the balance of the book to purely numerical methods. These include methods as those of Frobenius, etc., which involve power series as well as such methods as those of Euler or Kutta which express values of y corresponding to tabulated values of x. There is a chapter devoted to the process called by the authors "Forward Integration," that is, methods which allow an integration started by a specified method to be continued with a minimum of effort.

Although the underlying theory is by no means neglected, the primary emphasis of this book is on methods of solution; in this respect it is exceptionally complete. In addition to a number of carefully worked out illustrative examples, there is a fair number of examples for solution. The book should certainly be available for reference where there is any need for such solutions. The book has no index, but the table of contents is rather complete. One particularly valuable feature is the detail with which the various steps of the solution are shown.

CECIL B. READ

VECTOR AND TENSOR ANALYSIS, by Harry Lass, *Assistant Professor of Mathematics, University of Illinois.* Cloth. 15.5×23 cm. Pages xi+347. 1950. McGraw-Hill Book Company, Inc., New York, N. Y. Price $4.50.

Even casual examination of this text will reveal an exceptionally wide range of

topics covered. The book is planned as a text on the senior college or graduate level. The student in allied fields will need at least mathematics through the calculus to follow the treatment; the student in mathematics will have difficulty in following the treatment of some of the topics in physics (electrostatics, magnetostatics, hydrodynamics, mechanics, for example) without considerable background.

In addition to chapters on vector algebra and vector calculus, the text has a chapter on differential geometry, two chapters on tensor analysis and Riemannian geometry, and three chapters on applications to physical problems. There are many illustrative examples (151) and over 500 problems for solution. As might perhaps be expected, the number of problems varies from section to section, in a few instances some instructors might wish a larger or more varied list. Problems are not always graded in order of difficulty, and vary from elementary illustrations to extension of the theory. Answers are not furnished.

Whether or not the book will be suitable as a text in any particular course can probably be determined only by examination of the book itself. In most cases it will be doubtful if half the book is covered in a single semester course. At times the treatment seems exceptionally clear and on a relatively elementary level, at other spots the material might even have been written by another author, for a much more mature group. For example, the treatment of point set theory on pages 89 ff. and the discussion of the difference between a contravariant and a covariant vector (pages 273 and 293) seemed to the reviewer exceptionally clear and well written. On the other hand, the treatment of determinants on page 263 and the four pages following (with the implication that the only previous contact of the student with this subject is the treatment of second and third order determinants in elementary algebra) might be an example of a situation requiring much more maturity on the part of the reader.

It is doubtful if there is as complete a book in print, especially as it relates to the applications of the subject. Even if the book is not found suitable for a text, it could well be placed in the university library for reference.

CECIL B. READ

THEORY OF SETS, by Dr. E. Kamke, *Professor of Mathematics, University of Tubingen*. Translated by Frederick Bagemihl, *Assistant Professor of Mathematics, University of Rochester*. Cloth. 13×19.5 cm. Pages vii+152. 1950. Dover Publications, Inc., New York, N. Y. Price $2.45.

This small book gives an exceptionally well written treatment of the theory of sets. It could well serve as a text in a brief course, but is probably of greatest value for supplementary reading or for study by the individual who wishes to gain some knowledge of set theory by independent reading. The student who has encountered references to such topics as ordinal and cardinal numbers, ordered sets, enumerable and nonenumerable sets, the cardinal number of the continuum, without a clear idea of just what these concepts imply, will find no better method of clarification of the meaning of these and similar concepts.

Although some degree of mathematical maturity is required in order to follow the thought, essentially all of the material can be followed by one who has completed a course in college algebra (the first phrase should indicate that it is doubtful if a second semester college freshman will read the book with profit). There is a considerable number of illustrative examples, but no collection of exercises to be worked by the reader. There is a key to symbols, a very brief bibliography, and a fairly complete index. The primary emphasis is upon the general theory of sets, only some seven or eight pages are devoted to the special topic of point-set theory.

CECIL B. READ

JACOB STEINER'S GEOMETRICAL CONSTRUCTIONS WITH A RULER GIVEN A FIXED CIRCLE WITH ITS CENTER. Translated from the first German edition (1833) by Marion Elizabeth Stark, *Professor of Mathematics, Wellesley College*. Edited with an Introduction and Notes by Raymond Clare Archibald, *Professor Em-*

eritus of Mathematics, Brown University. Cloth. Pages 88. 17×25 cm. 1950. Scripta Mathematica, Yeshiva University, New York, N. Y. Price $2.00.

This is the first English translation of Steiner's work in which he shows that any point which can be constructed with ruler and compasses can be constructed with ruler alone, if a circle and its center are given in the plane of construction. The work is especially valuable because of the historical introduction and notes by Professor Archibald. There are, following an introductory survey, three chapters in the work itself: I, dealing with properties of rectilinear figures, including harmonic rays and points, and constructions when parallels or rationally divided segments are given; II, properties of the circle, including harmonic properties, center of similitude; III, dealing, with the preceding two chapters as a basis, with the general solution of geometrical problems with the conditions stated.

No extensive mathematical background is required to read the book other than some general mathematical maturity. The book would be extremely valuable as collateral reading in a course in projective or in college geometry, as well as a course in the teaching of mathematics. Likewise it would be fine material in a course in the history of mathematics. Some of the problems will prove intriguing to a superior high school geometry student. Certainly this book should be in every college library and would be of value in a high school library.

CECIL B. READ

PROGRESSIVE PROBLEMS IN PHYSICS, by Fred R. Miller, *Formerly Head of the Department of Science, The English High School, Boston.* Sixth Ed. Pages vii +237. Appendix. D. C. Heath & Co. 1949. $2.00.

This small volume contains 1371 problems in physics running the standard gamut of subject matter arranged in topic sequence. Under the heading *General Miscellany* are some twenty problems taken from the College Board papers (1939-41). Several hundred additional problems are taken from other CEEB exams and the Regents' Examinations of New York. The problems under each heading are pretty well arranged in order of difficulty. No answers are given. The Appendix contains a number of conversion and numerical tables, and a brief four-place log table.

With every physics book containing numerous problems (far more than can be worked by a class) in each chapter and some with pages of supplementary problems the reason for such a compilation as this appears difficult to give. Very few, if any, of the problems involve any cerebration—indeed, most of them lend themselves at once to mere formula substitution! The *principles* of physics could hardly be taught from this book alone, even though the author states so in his preface. If answers were supplied it is conceivable that this volume might be used by students for practice work whereby they could work at random throughout the list and check their results immediately.

Concerning Tables and Physical Constants, it is my firm conviction that elementary students should not be burdened with this terrific confusion of conversions. *This contributes nothing to their learning.* Indeed, I insist on their knowing only TWO—1 inch = 2.54 centimeters; 1 kilogram = 2.20 pounds! From these all other ever-needed metric-British conversions can be derived. If ever other data are required the Handbook of Chemistry and Physics is an excellent book for *every* student and teacher to *own*. There are presumably physics teachers who can profitably use such a compilation as this and they cannot, obviously, go wrong for two dollars!! But the utility of dekaliters and hektoliters and the confusion of such abbreviations as cl. and Dm. are obviously dubious! My point of view, however, can hardly be right, since the book is now in its sixth edition. But we would do well to look again at the product which emanates from our high schools generally. It is conceded that this was never at a lower intellectual level. What we need is some old-fashioned classical training in cerebration—which the rote performance with problems which are purely substitutional can never achieve.

JULIUS SUMNER MILLER
Dillard University
New Orleans, Louisiana

Essentials of Electricity for Radio and Television, by Morris Slurzburg and William Osterheld, *Instructors in Dickinson High School, Jersey City.* Second Edition. Pages xi+533. Table of Contents. Appendices. McGraw-Hill. 1950. $4.00.

This text is a revision of the authors' *Electrical Essentials of Radio* extended to cover the fundamentals of frequency-modulation, television, H F. transmission and reception in a.m. and f.m. and television receivers. The exposition is elementary, clear, and basically sound. The notion of electron flow is good physics, and the operational point of view in definitions is highly acceptable. Occasionally the language is bad and the meaning thus somewhat obscured, but these faults are not glaring. Illustrative examples appear profusely. Drawings and photographs are numerous. The units, symbols, and abbreviations are acceptable and up-to-date. Each chapter ends with an excellent bibliography, a set of questions, and a substantial set of problems, the latter devoted in large measure to real situations. The Appendices are excellently done and are of eminent utility. The book would be a profitable investment for a radio amateur (beginner) or an elementary student in the field. Answers are provided to about half the problems. The complete answer book is available. The paper and page format are excellent. The authors are deserving of high commendation.

Julius Sumner Miller

Discovery Problems in Physics, by H. F. Turner, *Head of Science Department, Eastside High School, Paterson, N. J.* Revised Edition. Pages 352. Paper Covers. College Entrance Book Co., New York City. Price $1.00.

This "Workbook and Laboratory Manual for Use with Any Physics Text" is worth the price for the cartoons alone. The Units to number XIV are each prefaced by a full page of six cartoons which are eminently well done. These pencil sketches bear excellent captions like "What holds a stamp on an envelope?" or "Why can a bug walk on water?" Under each unit are stated two or more "problems" (there are 41) such as "What determines the color of objects?" and under each problem, in general, are several experiments. (74 of these).

The Problems consist of an array of statements requiring completion as well as some numerical exercises invoking physical principles. The experiments are simple and well diagrammed. The discussion questions are good. The illustrations are interesting and stimulating. Each Unit ends with a Self-Testing Exercise which is very satisfactorily put up. Detailed textbook references to an array of authors appear at the beginning of each unit.

It appears that this manual (designed for high school physics) would lend itself eminently well to any textbook and in my judgment constitutes an excellent instructional device. The diagrams in the Students' Review Summary are cleverly done in black and red and thereby are psychologically stimulating. A bit of nuclear physics is included.

Since we are now, on the juvenile level at least a picture-reading people, this manual should be instructionally helpful. As for the cartoons, I have mounted them on my bulletin board!

Julius Sumner Miller

First Principles of Atomic Physics, by Richard F. Humphreys, *Formerly Associate Professor of Physics at Yale,* and Robert Beringer, *Assistant Professor of Physics at Yale.* Pages ix+390. Cloth. Appendix. Harper & Brothers. 1950. Price $4.50.

It must be stated at once that the title of this very excellent book was totally misleading to me and on this count its prosperity may suffer. Teachers will generally, I fear, think it is something it is not. I expected a text on atomic physics to be used, perhaps, with upper classmen or first-year graduate students in physics. The emphasis is indeed on atom physics but not in the sense the title implies. The Preface, however, states beautifully the intent of the book and indeed, *this* preface describes the text so eminently well that I must quote freely from it. If it

appears that I have quoted unduly I can only say that the stature of this book is deserving of it; in no other way could I portray (in a language of my own, say) the authors' intent and ideas.

"This text is designed for use in an introductory physics course for the student of the humanities or the social sciences. Its essential task is to present the physicist's modern view of the natural world in the limited time which the general student can devote to such study and without using all of the physicist's analytical equipment.

For the science student the introductory course merely sets the stage for more intensive study, but for the general student one must design a terminal course which carries the student to some over-all picture which he can incorporate into his general knowledge. One attack on this problem has been the survey course; another is the historical or philosophical approach to science. We do not accept either of these as wholly valid, since they do not use the scientist's methods in treating physical phenomena. There is a vast difference between teaching science and teaching *about* science. In this text we have chosen to teach science, and acknowledge the limitations imposed by a single nonprofessional course by selecting carefully from the whole body of physics a portion which can be constructed logically and with some degree of termination.

In pursuit of this aim we have made no attempt to be comprehensive. Instead, one field of thought—the physicist's concept of the atomic world—is developed with the aid of only that part of macrophysics whose understanding is required in atomic physics. Indeed, most of the material of the conventional physics course is omitted, while much is included which is not normally found in elementary books. It is believed that an integrated view of physics can thus be presented more successfully than in an abbreviated version of the usual introductory course. The plan is thus diametrically opposite to that of the nontechnical survey or general science course.

The school training and the aptitudes of the general student pose a number of difficult problems to the college physics teacher. One of these is the use of mathematics, which must be kept to a minimum, for few students possess outstanding mathematical training. Yet one must not present a course without mathematics, since this would seriously distort the physicist's methods and sterilize the logic of physics. We have tried to meet this problem by employing only algebra and geometry in derivations and proofs and by including even the more obvious steps which are "easily shown." Where a logical construction demands it, the mathematical treatment is more rigorous than that of the usual introductory text, and, in particular, there are fewer results set down without proof. A real attempt has been made to carry through the mathematical reasoning that leads from general principles to experiment and application.

A glance at the contents of the book will show its "vertical" plan of attack, the extent of this plan, and the scope of its omissions. In brief, the subjects treated are particle dynamics, electrodynamics, and atomic and nuclear phenomena. Particle dynamics is based on Newton's laws of motion. Rigid body dynamics, fluid dynamics, and machines are almost completely omitted; on the other hand, the conservation laws are treated rather fully. The next section introduces the atomic hypothesis and applies dynamics to atomism by way of the kinetic theory of gases. In electrodynamics the view is again essentially atomic. Circuit theory and electrical machinery are minimized. The atomic physics section treats atomic phenomena and their interpretation on classical and quantum mechanical grounds. Particular reference is also made to light propagation and the ether paradox, and some development in special relativity is carried out. In the final section nuclear phenomena are considered. Emphasis is laid on the role of the Einstein mass-energy equation in nuclear reactions; the last chapter describes neutron physics and nuclear fission.

A course including the material of this text may cover either one or two se-

mesters, depending on the frequency of meeting and the extent of outside reading and problem assignments. It is now being taught to freshmen at Yale for the eighth time as a one-semester course meeting for three lecture-demonstration sessions and one discussion plus laboratory session per week. Both student-performed and demonstration experiments are employed, arranged to correspond with the lecture material as closely as possible. Classes, discussion section, and laboratory are conducted by the same instructor and limited to thirty students. Their response as well as that of the instructors participating has been largely encouraging, and we feel that the present approach to the problem of making science meaningful to the liberal arts student has been shown to be feasible."

The problem of bringing science, especially physics, to the general student ranks among the most important instructional issues facing us today. The rage of so-called survey courses in recent years is well known. The historical and philosophical approaches (as at Harvard) are further attempts to resolve the dilemma. These authors now bring to the scene still another approach, ***and they should be heard***. On this count this long quotation is justified.

The exposition is elegantly clear and the diagrams are excellently done. Each chapter ends with a few elementary problems and a brief select list of Suggested Reading. This book is a very substantial departure from the conventional physics text. It borders on the "block and gap" method which appears destined to wider usage. ***Most of the standard gamut of the conventional physics course is left out!***

Whether the liberal arts student will come away from this course recognizing the boundaries of human knowledge which physics embraces is somewhat questionable. Maybe he ought to know why it is cooler under a maple tree or why a clothesline gets tight when wetted or why a glass filled with ice and water will not spill over even when the ice melts. He ought certainly to know that such problems exist and that they're in the physicist's domain. The issue here is moot.

Teachers throughout the land should see what these authors have done.

JULIUS SUMNER MILLER

ALUMINUM PREFAB PROTECTS SOLDIERS FROM WIND AND COLD

Complete protection from 100-mile gales and sub-zero weather is provided for soldiers by a new aluminum prefabricated building developed by the Army Engineer Research and Development Laboratories in collaboration with Chrysler Corporation.

It is a box-shaped structure with flat roof that can be erected quickly in the field. It is 20 feet wide and eight feet high, and can be any multiple of eight feet in length that may be desired. The unit now under tests is 48 feet long.

The prefabricated parts are restricted to approximately 100 pounds in weight for easy handling. The structure utilizes channel aluminum floor beams, and panels for walls, roof and floor made of honeycomb construction. The panels are an aluminum alloy. The inner and outer sheets of the alloy are separated by a craft paper impregnated with a resin and shaped to resemble the familiar honeycomb. This type of panel has both strength and resistance to heat passage.

Panels are held together by simple wedge-type connector pins. No special skill is required for erection; the job can be done by ordinary soldiers. Each unit has its own heating and sanitation facilities. The furnaces are oil-fired and blast-driven. They provide a hot-air heating system. An indoor temperature of 70 degrees Fahrenheit can be maintained even when the outside temperature is 65 degrees below zero.

PROMOTION OF MATHEMATICS AND SCIENCE

ALLEN F. MEYER, *President CASMT*

Who is going to teach mathematics and science and who is going to study mathematics and science? The hopes of mathematics and science teachers and pupils can reasonably be expected to be based upon whatever facts and true relationships there are. The opportunities for production for most teachers and pupils are nearby, in local environments. The "group dynamics" which have been observed in many schools make too little provision for the time required at each level of pupil progress for appreciation, let alone thorough mastery, of such fundamental subject matter. Rationalizing, perhaps, it is found more convenient for the public relations program of the school to spend the time on recreational and entertainment aspects of education which do not depend, for the moment, upon the exactness of mathematics and science. To be sure, in some loose manner, the appointments or the script of the occasion may refer to the existence of mathematics and science.

The significance of mathematics and science in education might be established in the minds of school patrons and pupils, and understood, with benefit to the school community, by actual demonstration. Many things are more readily illustrated and demonstrated than explained. The point at hand is to encourage teachers of mathematics and science to study their respective communities, to prepare interesting useful programs for public enlightenment and to illustrate and demonstrate publicly both the practical and entertaining values of mathematics and science, which are many. Other subject matter interests do this, reasoning from the particular to the general that the growth of the whole child is thus being considered. Perhaps mathematics and science, once demonstrated by understanding pupils, helpful patrons and teachers, can be more fully appreciated.

ARCTIC HANGAR-TENT

A new traveling pup-tent for U. S. fighter planes has been developed by the Air Force and Navy. Designed primarily for sub-zero temperatures of any future war in the Arctic, the shelter can be used anywhere, is large enough to hold any American fighter plane.

The tent's fabric has an inner lining of glass-fiber cloth to provide insulation. The vinyl-coated fabric has an aluminized inner side to reflect heat and light.

Design and development of the new shelter was a cooperative project of the Air Force, Navy and General Textile Mills. Its roof is held up by four aluminum corner posts and five aluminum roof trusses. There are no internal supports or obstructions.

Tent and frame together weigh less than 5,000 pounds. The structure is designed to withstand winds of 70 miles an hour and a snow load of 30 pounds per square foot.